PRACTICAL POULTRY MANAGEMENT

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PRACTICAL POULTRY MANAGEMENT

5th Edition

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PREFACE

To the Fifth Edition

The scarcity and high cost of labor have focused attention on more productive work per man on the poultry farm. Hence, labor-saving construction and equipment and arrangement to save steps and reduce costs per bird are resulting in changing patterns of handling poultry.

The size of houses, pens, and individual flocks of layers, breeders, and chicks is increasing. Coming rapidly into use are heating cable and other protection devices for continuous-supply water systems in winter, fan ventilation, nesting rooms for large flocks, community nests for smaller flocks, permanent brooder systems, disposal pits for dead birds and waste, and methods of increasing operating efficiency.

Research has changed the emphasis in formulating rations. The war brought about the discovery of new sources of vitamin D. During the same period, combinations and relations of various minerals and nutrients in feeds assumed important economic meanings that prior to this had not been fully recognized.

The relative economic importance of certain diseases has changed, and new methods of control have been discovered.

National uniformity of standards for quality of eggs and grades is an important question. Federal standards for quality have recently been revised.

The authors have brought this Fifth Edition abreast of the times, including a revised key for breed identification that contains all varieties in the latest *Standard of Perfection*.

The authors desire to express their appreciation to all who have aided in any way in the preparation of this edition, and particularly to Dr. G. F. Heuser and Dr. E. I. Robertson for

suggestions and material on feeding poultry, to Dr. P. P. Levine for assistance with the chapters on diseases, and to Mr. F. E. Andrews, who checked the chapters on incubation.

THE AUTHORS AND EDITORS.

PREFACE

To the First Edition

Poultry Husbandry is both a science and an art. As a science, it deals with the facts, principles, and natural laws underlying the successful management of poultry. Many of the scientific principles set forth in this book are comparatively new, although numerous practices based upon them have been followed for centuries with good results.

The art of Poultry Husbandry is the skill needed to put these principles into practice. One may imitate his neighbor's practice and thus unconsciously use scientific principles. In order to practice the true art of Poultry Husbandry, however, one must have a knowledge of these basic principles coupled with the skill to apply them successfully.

This book is prepared as a guide to vocational school pupils and poultrymen, whether they keep poultry on a commercial scale or in small flocks. The suggestions have been carefully tested through research and experience. The chapters are organized about the major activities in conducting the poultry enterprise. Where operative activity is involved, specific directions have been included for performing each job. Under the caption "General Information" or in separate chapters, explanations of principles and practices related to these activities have been included. For the most part, those activities dealing with managerial or local business decisions have been left for the development of individual teachers, to meet the needs of local groups of pupils and local enterprise and market practices. The community surveys at the close of many chapters, and particularly the study outlined on page 491, will serve as a guide to pupils and teachers in studying such managerial activities.

The essential key-factor in the successful management of a poultry enterprise is efficient stock. Because of the impor-

tance of this phase of the business, the operations of culling have been included as Chapter I. In the remaining chapters an effort has been made to pursue a seasonal sequence of activities throughout the year. In this connection, however, it will be noted that many operations are conducted throughout all seasons.

The authors desire to express their appreciation to the following members of the Poultry Department at Cornell University who read and improved portions of the manuscript in their special subject-matter fields: Mr. R. C. Bradley, Sanitation; Mr. G. O. Hall, Breeds, Breeding and Culling; Dr. G. F. Heuser, Feeding; Mr. J. C. Huttar, Caponizing; Dr. L. C. Norris, Feeding; Dr. C. K. Powell, Marketing; and Professor L. E. Weaver, Incubation and Brooding; also to Mr. W. G. Krum, who read the entire manuscript, and Messrs. F. E. Andrews, L. M. Hurd, and R. C. Ogle, each of whom contributed in many ways to the book.

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Grateful appreciation is tendered Mrs. Harold E. Botsford, who gave many days to the development of this book.

Chapter IX is almost entirely from Cornell Bulletin 90, by Professor F. L. Fairbanks, Department of Rural Engineering, Cornell University.

The great majority of the pictures were especially taken by the authors to illustrate the text, and a number are from the Poultry Department at Cornell University.

In several instances illustrations from books and experiment station bulletins and educational material from commercial firms have been used, for which the authors express their appreciation. Credit has been given in all cases.

THE AUTHORS AND EDITORS.

CONTENTS

CHAPTER I

CULLING THE FLOCK

One of the most useful, satisfying, instructive, and inspiring types of work with poultry is culling the flock.

Culling is useful because it gives the good producers more room at feeding time, less crowded perches, and cooler quarters at night. It is satisfying because it enables the poultryman to eliminate the poor producers, saves feeding them when no return for eggs can be expected, and places them on the market at the time of higher prices. It is instructive because the observing person will learn much about poultry by handling the birds individually. Finally, culling is inspiring because this particular work opens up a field in which one can quickly see results. It leads one to form the habit of observing daily the quality and condition of the stock. It creates a desire to see better birds and to handle and breed them so that there is continual improvement in the flock.

Operations:

1. Deciding when to cull.
2. Deciding upon the culling method to use.
3. Preparing to cull.
4. Catching the birds.
5. Holding the birds.
6. Culling the birds that are not laying.
7. Continuing the examination.
8. Comparing good and poor laying hens.
9. Selecting pullets for the laying pens.
10. Finding the laying pullets.
11. Discarding old males.

General information:

Types of culling.

1. Deciding when to cull

Throughout the year culling may be done by removing birds that appear to be out of condition or not laying.

FIG. 1. Culling the flock by flashlight at night. A quick examination of the comb, other head parts, and the plumage results in rapid and reasonably accurate culling.

Culling low producers is best accomplished during the summer. A few birds cease laying in May or June and may be removed by carefully separating them from the flock and catching them in the pen, with hook or net. Removing culls from their perches at night by flashlight is easy and reasonably accurate. This is sometimes the most practical way to cull. Later in the summer larger numbers will cease to lay, and, when many culls are present or only one or two cullings can be given during the summer, the flock should be systematically culled by handling and examining every bird.

2. Deciding upon the culling method to use

Two methods of systematic culling are practiced: (*a*) culling by trapnest or laying-cage records and (*b*) culling by external characters.

The trapnest method of culling involves trapping the flock and removing from the pen any birds that are not recorded as laying or that are otherwise undesirable. Trapnesting requires a great deal of labor and is an expensive way of culling. An individual egg record can be kept of birds in laying cages, and culling can be practiced when they cease to lay. A knowledge of the external characters is always desirable. Trapnests or laying cages should not be used for the sole purpose of culling.

3. Preparing to cull

(*a*) Become acquainted with the conditions under which the flock has been kept. Culling cannot be accurate unless the feeding, housing, and sanitary conditions have been such that good birds could lay. (See Chapter XXIV for the summer care of poultry.)

Many hens do not lay simply because they cannot under existing conditions, even though they may be naturally productive. If all non-laying birds were removed at this time, some valuable hens might be culled. In this event, they should be culled less severely, and if feed costs are not excessive the flock should be placed under desirable conditions at once. Culling may proceed after a month or 6 weeks.

If birds have been properly cared for, they may be culled at any time.

(*b*) Provide a place in which to put the culled birds.

(*c*) Confine the hens to their house or pens the night before they are to be culled.

(*d*) Prepare the equipment for catching and confining the birds.

4. Catching the birds

(*a*) *Night flashlight culling.* Pass in front or rear of the perches and, by flashlight, remove birds with shrunken or hard or limp combs or obvious molt. Place in crates or cull pen. If the hens leave the perches, subdue the light with one or two fingers. Next morning handle each bird and either cull or keep. A reasonably complete job of culling can be done this way quickly, easily, and with little disturbance.

FIG. 2. Catching crate in position. Note sliding door and handle. The crate is convenient for use in culling or moving chickens.

(*b*) One daytime method is to place a catching and carrying crate (Fig. 2) at the exit door, on the outside or between pens. (The exit door should be in a corner of the pen, to facilitate driving.) Drive 20 to 30 birds into the crate, depending upon the size of the crate.

FIG. 3. A fish landing net is ideal for catching birds. Approach the hen quietly and with a quick movement slip the mouth of the net over her head. Bird is caught but is neither harmed nor disturbed.

(*c*) The *net* may be used to advantage when one wishes to catch a few birds rather than handle the entire flock. The bird desired may be carefully separated from the rest of the

flock and caught without disturbing the others (Figs. 3 and 4). Some prefer to use the *catching hook* (Fig. 7).

(*d*) Rounding up with *wire screen or panel* is a satisfactory

FIG. 4. Catching wild or frightened birds. Start the bird running beside a fence or building and suddenly thrust the net in front of the bird, which runs into it.

method using 10 to 15 feet of poultry fencing, 5 to 6 feet high.

Fasten one end to the wall 4 or 5 feet from a corner and hold the other end out into the room. Drive 20 to 25 birds toward the corner, carrying the loose end of the fencing around them. The person operating the fencing should be inside the pen as the fencing is drawn closer. Fasten the end to the wall when the space inside is small enough. Pick up the birds and pass them over the wire to the person culling.

FIG. 5. The three parts of a desirable catching hook: *A,* handle with hole bored in the end and with hole in the side for the nut; *B,* nut; *C,* hook which enters the hole and screws into the nut. The wire found in roofing paper makes a satisfactory hook.

Pens may be arranged outside, by using catching crates or wire.

5. Holding the birds

The following manner of *holding* the birds will be found convenient for right-handed persons. A left-handed person may desire to do just the opposite.

By grasping the wing close to the body (Fig. 8), lift the bird to be examined from the floor or catching crate. Hold the left hand flat in front of the body with the back of the hand toward the ground, thumb pointing away from the body, fingers together and at right angles to the thumb.

FIG. 6. Catching hook assembled.

With the bird's head toward you and the legs straight out behind, place the legs in your left hand so that the hock joint rests just at the edge of the hand near the forefinger. Grasp the legs with the thumb and fingers (Fig. 9).

Support the bird by placing the fingers of the right hand on its breast. If the left hand is too far down toward the feet or above the hock joint, the bird can bend its legs and may flop and cause trouble in holding; but when it is held as described, the legs are kept straight by the use of the forefinger and cannot be bent enough to become unwieldy (Fig. 9).

FIG. 7. Using the catching hook. The hook is slipped around the shank. The foot prevents the leg from slipping through.

The bird may now be turned in any direction for examination without releasing the left hand, the right hand being used to help turn and hold the bird's body (Fig. 9).

6. Culling the birds that are not laying

A hen that has recently been broody, although perhaps not laying, should not be culled unless she has been broody at least twice or it is late in the season. (See Chapter XXIV for method of marking broody hens.)

Sick birds should be culled. In most cases they will not be laying.

Examine the hen, whether separating individuals on the floor or handling every bird, looking for the characters described in the following paragraphs in the order in which they are given. These characters indicate a hen that is definitely out of production. If any character is not as pronounced as here indicated, and if there is any doubt whether the hen is laying or not laying, check it with the other characters mentioned.

FIG. 8. Lifting a bird from a catching crate.

Examining the comb, corner of mouth, vent, and plumage. When the comb is shriveled and dry, it is a sign that the bird is either out of production or is slacking up in her laying (Fig. 11).

FIG. 9. *Left:* Grasping the legs preparatory to examining a bird. *Right:* Bird in position for examination.

While holding the bird in the left hand, grasp the wattles with thumb and middle finger of the right hand, place the forefinger on the tip of the upper beak and force open ⅛ inch. Examine the base or corner of the beak where the skin joins

the upper and lower mandibles. Pale yellow or deep yellow color there shows production has slowed down or stopped.

Still holding the legs, place the back of the bird against you and, with the fingers of the right hand, part the feathers until the vent is exposed. In most cases when the comb is as

FIG. 10. High producer, full laying. Note full, bright, stiff, waxy comb and wattles; pale color of beak, eyering, earlobes, face; bright, round eye.

FIG. 11. Low producer, not laying. Note small, hard, dried, scale-covered comb and wattles; yellow color of beak, eyering, earlobes, face; dull, snaky eye.

described above, the vent will be dry, puckered, and yellow [1] (Figs. 12, 13), indicating that the hen is not laying.

Now look among the neck and body feathers for signs of a molt, and see if there are pinfeathers or if there are unmistakable signs that the old feathers are being dropped and new ones growing in. New feathers are bright, and in many of the newer ones there will be bloody liquid in the quill at the base. Old feathers are usually worn, soiled, and perfectly dry at the base. A bird shedding her coat early in the summer is likely to be out of laying. (See page 22, Molt.)

[1] This applies to yellow-skinned varieties. (See pages 566 and 572.) For white-skinned varieties, such as Orpingtons, Minorcas, etc., the yellow test does not apply.

Hens that appear as just described are not laying and may be removed from the flock.

On many hens, however, these characters may not be clearly

FIG. 12. Laying. Note distance from rear end of keel to vent; large, dilated, loose vent; pubic bones wide apart.

FIG. 13. Non-laying. Note hard, plump condition of the body, contracted vent, and close pubic bones.

marked; and when one is not sure whether the bird is laying, it is well to check further.

7. Continuing the examination

(See Chapter II for the principles governing these changes.)

The following characters indicate that a bird has not recently laid heavily.

A. Beak. Pale yellow or deep yellow color extending, with no break in color, part or all the way to the tip.

B. Eyering. Pale yellow or deep yellow on the eyering or the inner edge of the eyelid next to the eyeball.

C. Earlobe. Pale yellow or deep yellow on the earlobes of white-earlobed breeds.

D. Pubic bones. Thick, blunt pubic bones which are close together. (These are the two bones just below and on either side of the vent.)

FIG. 14. Front view of bird in Fig. 10. Note full comb and wattles.

FIG. 15. Front view of bird in Fig. 11. Note shrunken comb and wattles.

FIG. 16. Testing the abdomen. On removing the hand, press gently with the thumb and fingers. A soft, pliable abdomen often allows the fingers to meet with only skin between. The abdomen of a poor producer may be filled with fat and be hard, preventing the fingers from meeting.

E. Abdomen (Fig. 16). A shrunken "tucked up" abdomen or one filled with a hard material.

8. Comparing good and poor laying hens

Because many hens do not show these characters as definitely or in as advanced a form as just described, further study may be desirable.

Culling poultry is a balancing of characters; one should be checked with another. Except in extreme or unmistakable cases, and until one has had considerable experience, hens should not be culled on the basis of any one character alone.

When learning to cull, practice studying each character. Later, one should take in several characters at a glance, weigh them mentally, and arrive quickly at a decision.

It is well also for beginners, while learning to test the accuracy of their work, to keep the culled birds a week or so.

The following characters, as found on a good and on a poor layer during the summer, are arranged for quick reference. The longer the hen is out of production, the more the poor layer's characters will be intensified.

The beginner should work through the characters as given under Section 6, "Culling the birds that are not laying," until they are clearly in mind.

Good Layer	Poor Layer
Comb	
Large, full, plump, smooth, waxy. If the comb is cold, but of good size and full, she is laying regularly.	Limp (if laying slightly). May be covered with white scales.
Beak	
White or well bleached.	All or partly yellow. Yellow color at the base of the beak, and extending out toward the tip.
Eyering and Earlobe	
White or well bleached.	Yellow or tinted.

FIG. 17. A good layer. Note pale color of beak, eyering, earlobes, face, shanks; old, unmolted, ragged plumage; full, bright, waxy comb; full earlobes; deep abdomen; intelligent head.

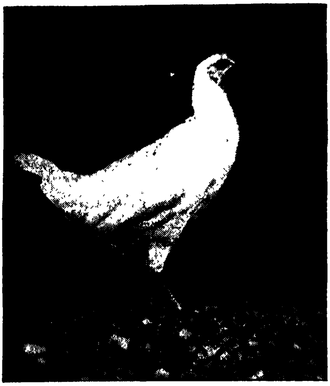

FIG. 18. A poor layer. Note yellow color of head, shanks, plumage; new plumage; small, hard, dried, scale-covered comb; wrinkled earlobes; tucked up abdomen, full face.

GOOD LAYER (Cont.)	POOR LAYER (Cont.)
Vent	
White or well bleached. Large, soft, moist, oval. Sometimes its fullness causes the upper part to appear overhanging.	Yellow or tinted. Small, hard, dry, round. Sometimes appears contracted.
Molt	
Sheds late and rapidly.	Sheds early or before September and usually slowly.
Pubic Bones	
Thin, pliable, and relatively wide apart.	Thick, blunt, and relatively close together.
Abdomen	
Loose, pliable, soft. Full when in laying condition. Deep from the pubic bones to the rear of the keel.	Tight, hard, tucked up. Rear end of the keel rather close to the pubic bones.

(For selecting birds while in laying condition or when both good and poor hens are laying or not laying, see Chapter XVI.)

9. Selecting pullets for the laying pens

Pullets that have been properly culled and handled while being reared will need little culling at sexual maturity.

Pullets showing little or no comb development should be left on range until nearly ready to lay. If it is necessary to house them earlier, place them in a separate pen until mature.

Flocks of pullets that are to be held in winter quarters may be examined and selected on the basis of the following points which aid in determining their suitability.

A. Size and health. Well developed combs, well fleshed bodies, large for the age and breed, active, and of good vitality.

B. Pigmentation. Strongly pigmented, when reared under good range conditions. Pale heads and shanks are undesirable on yellow skinned varieties.

C. Type of head [1] and body. Well proportioned and smooth feathered.

10. Finding the laying pullets

From time to time after the pullets have been housed, it is desirable to cull any which may not be performing satisfactorily. Any that are weak or sick should be removed. Culling pullets which have started to lay may be based on the following information.

Early sexual maturity. Other things being equal, the pullets that are well developed usually begin to lay earliest. A bird is said to be sexually mature when she starts to lay. Sexual maturity and physical maturity (maximum body weight) do not necessarily occur at the same time. Pullets reach physical maturity at about 10 months of age, but sexual maturity may be reached much earlier in life.

[1] Consider the color of the eye cautiously when culling Leghorns since it may be related to the ration fed. Rations with, or without, yellow pigment cause yellow to be deposited, or not to be deposited, in the iris respectively. Laying pullets, in recent tests at Cornell, did not store the pigment, and well pigmented irises faded when the birds were fed pigment-free rations. Also there is no important relation between the iris color in dams and the mortality of the progeny. (See page 248, Iritis.)

For several months, pullets which have reached sexual maturity early are producing eggs and growing at the same time.

Leghorns should reach sexual maturity between 5 and 6½ months, 150 to 195 days. Heavier varieties should reach sexual maturity at 6 to 7½ months of age, 180 to 225 days. Certain strains are bred to lay earlier or later than other strains. When purchasing eggs, chicks, or stock, one should inquire concerning the usual age at which sexual maturity in the strain is reached.

Ordinarily birds reaching sexual maturity early are heavier than those not yet laying. However, being young, they are of small size, and their eggs are small at the start. As they grow, their eggs increase in size. Pullets reaching sexual maturity late are larger when laying starts and lay larger eggs because of their larger bodies. Eggs laid by equally aged pullets are of the same approximate weight regardless of the age at which laying began.

Leghorns reaching sexual maturity at 7½ to 8 months are less likely to be profitable. Heavier varieties are less likely to be profitable if sexual maturity has not been reached by 8½ to 9 months.

It is not necessary to handle all the pullets to find the non-producers at any age. The comb condition helps one to observe a doubtful bird on the floor. Such a bird should be caught and examined.

The development of the comb, size and condition of the vent, fullness of abdomen, and amount of pigmentation help one to decide. The pigmentation of a bird just starting to lay is exactly the reverse of that found in a high-producing hen ceasing to lay.

The eyerings, earlobes, and vent will begin to bleach. Examine the beak at the base. If the pullet is laying, and has laid several eggs, that section of the beak will be pale. The longer she has been laying, the lighter the beak will be and the nearer the tip the white part will extend. The degree of bleach-

ing present depends on the number and size of eggs, the rapidity of laying, and the kind of feed given.

11. Discarding old males

At the close of the breeding season all males should be removed from the flock (see page 304) and all males developing defects should be sent to market. The culling will be based on vitality and standard disqualifications and, if records are available, on fertility, hatchability, and progeny results.

GENERAL INFORMATION

Types of culling. There are at least three types of culling with which the expert culler is concerned. Each is somewhat more difficult than the preceding one.

The easiest kind of culling is that required in well-cared-for flocks, which may be culled several times a season. Hens that are not laying, and are not broody or have not recently been broody, may be culled. Any sick birds or birds in poor condition should be removed. This type or grade of culling is the easiest, in that it is mainly necessary to be able to determine whether or not a hen is laying. For this type of culling, the methods described in this chapter may be used.

The second type consists in culling the hens of a flock mainly according to their laying value, where but one examination is possible during the season. It becomes necessary to remove hens that are not laying and also those that may be laying but are poor producers at best.

The third type consists in culling only once a flock that obviously has been mismanaged at some time during the season and that contains hens laying and not laying, good hens and poor hens. This is extremely difficult, and there are few who feel that they can cull a flock under such circumstances and be perfectly satisfied when the job is done. In such a situation, it is best to place the birds under correct conditions for several weeks before culling.

The last two types of culling should not be attempted until the student is thoroughly familiar with Chapters II and XVI.

COMMUNITY SURVEY

1. How many poultrymen in the community cull birds the year around?
2. In which months is heaviest culling done?
3. Visit several poultry keepers and fill out the following form. Use it as a basis for class discussion.
   (*a*) Number of hens, November 1? Number of males, November 1?
   (*b*) When does summer culling start?
   (*c*) How often and when were the flocks culled?
   (*d*) Approximately how many were culled each time?
   (*e*) What price per pound was received for each lot of culls?
   (*f*) What effect, if any, was noticed on the flock after culling?
   (*g*) What method of catching the birds is used?
   (*h*) What percentage of the entire flock was culled during the year?
4. How many poultry keepers examine each pullet before placing in winter quarters?
5. What percentage of the pullets are usually culled out?
6. What points are considered undesirable in the culled pullets?
7. How many flocks of pullets are examined later for precocity?
8. Are any local poultrymen practicing a system of marking which will help them later in determining when an individual pullet began to lay?
9. Describe the method of marking used.

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CHAPTER II

PRINCIPLES OF SELECTION

In the commercial culling of poultry, it is comparatively easy to recognize the extremes of laying quality. The difficulty arises in working with medium birds. With a knowledge of the reasons why the various characters are significant in the selection of birds for production, one is better able to form a correct judgment regarding the value of any particular character or group of characters.

In general, these rules apply:

1. The pullet that began to lay late, stops early.
2. The pullet that starts to lay early, lays late.

The hen or pullet that begins to lay late in the fall or winter and ceases production early in the summer has had only a comparatively short time in which to produce eggs. Her length of laying period, i.e., the number of days from the time she began to lay until she ceased to lay, is short.

The hen or pullet that starts laying early and continues laying until late in the season has a long laying period. She, therefore, should be able to lay more eggs, and usually does so.

In a majority of cases, the bird having the short laying period does not lay as many eggs in a given week or month as the longer-laying hen; i.e., she is not as intensive a layer.

The principles of selection associated with the length of laying period are its related factors, persistency and precocity.

General information:

1. Persistency.
2. Precocity.
3. Season of laying as an indication of egg production.

1. Persistency

Persistency refers to a bird's ability to continue laying late in the fall at the end of her laying year. The greater persistency a bird has, the longer will be her laying period. To learn how persistent a layer the bird is, determine whether she is laying or not during the summer or fall. The sooner she ceases to lay in the summer, the less persistent she is. The characters denoting whether a hen is laying or not have been discussed (see Chapter I). They are pigmentation, molt, and condition of comb, vent, and abdomen.

A. Pigmentation: Its use in selecting pullets or hens starting to lay. Pigmentation is one of the first characters discovered, and it was found helpful in judging whether hens were laying. It indicates what a fowl has done, rather than what she will do, except as the future is judged by the past. In other words, it may be used to estimate her past production and thus to form an opinion as to her probable future production.

On yellow-skinned varieties, the yellow color is given to the fat by a pigment called *xanthophyll.* This color is present wherever there is fat. It is found in a thin layer just beneath the skin, in the shanks, beak, and all parts of the body where the blood circulates.

When a bird starts laying, either as a pullet or after a rest period, this yellow pigment gradually disappears. The loss of pigment is more pronounced in the softer parts of the body and where the circulation of the blood is most rapid.

From observations which have been made, it is possible to estimate the approximate length of time required for bleaching various parts of the body, and hence the time that has elapsed since the bird began to lay.

(1) *Vent.* The vent loses color fast, owing to the stretching of that part by laying. As a result, a marked paleness is noticed after 2 or 3 eggs have been laid.

(2) *Eyering.* The eyering, which is the inner edge of the eyelid, bleaches almost as fast as the vent. On Leghorns, the eyering in most cases can be seen plainly, but in heavier varieties considerable red may make the yellow less visible.

(3) *Earlobe.* Since the earlobe has a larger surface a bleached earlobe usually denotes at least 2 or 3 weeks of laying.

(4) *Beak.* Soon after laying begins, the beak, at the corner of the mouth, starts to bleach. As the bird continues to lay, the color continues to disappear until the entire beak is bleached (Fig. 19*B*). The lower mandible bleaches faster than the upper. The last place for the color to disappear is the arch at the front of the upper mandible (Fig. 19*E*).

A well bleached beak usually indicates 6 to 8 weeks of fairly heavy production.

(5) *Shanks.* Color change in the scales of the shanks is very slow. Hence, a well bleached shank shows good production for 4 to 6 months, depending upon the intensity of laying. The last places from which the yellow disappears are the scales just above the foot in front and the rear of the shank at the hock.

Pigmentation, therefore, indicates not only whether the bird is laying but also about how long she has been laying.

(6) *Consideration of pigmentation on hens during the summer culling.* When a hen ceases to lay, the yellow color is again deposited in the body as it was during the growing season. Fortunately, under normal conditions of feeding, it is deposited in the various parts of the body in the same order in which it was removed. It comes back slightly faster than it went out. Therefore, the pigment comes in first, as it went out first, in the softer parts, and in the following order: (*a*) vent and corner of the beak, (*b*) eyering, (*c*) earlobes, (*d*) beak, (*e*) shanks.

In a very few days after laying ceases, yellow color may be seen at the corner of the beak and in the skin about the edges of the vent. As time goes on, the pigment in each section deepens.

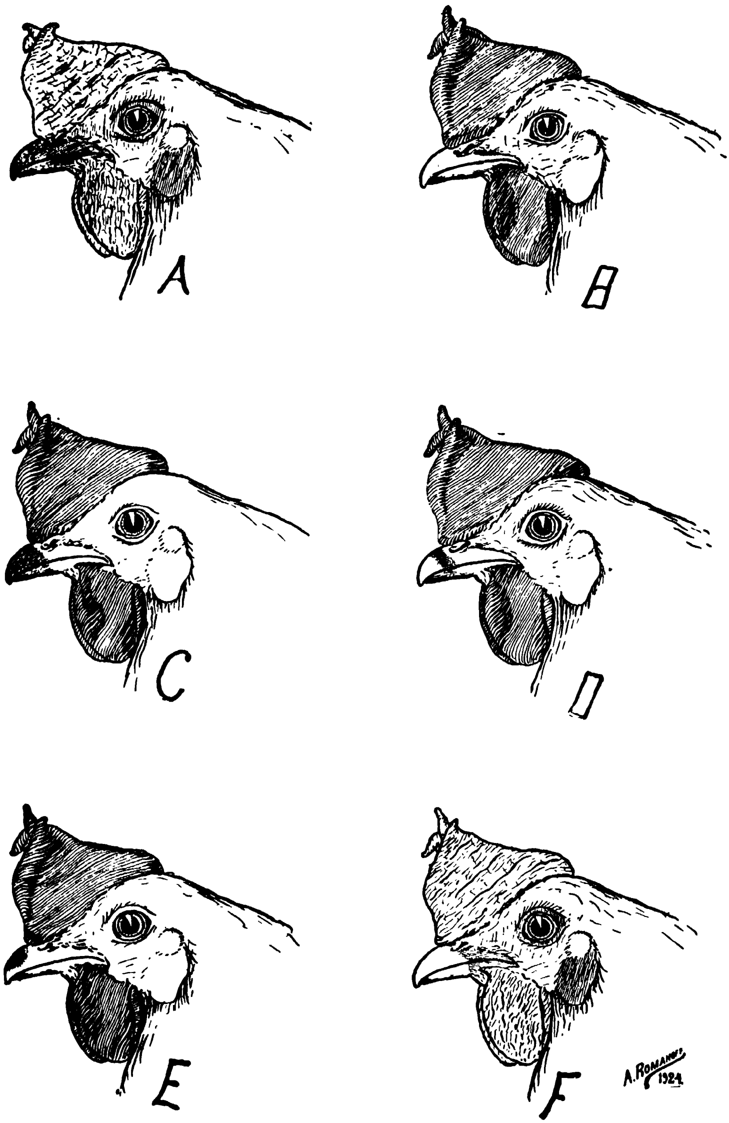

FIG. 19. A study in pigmentation (see text).

A yellow earlobe shows at least 1 to 2 weeks of non-laying, a yellow beak 3 to 5 weeks (Fig. 19*A*), and yellow shanks 2 to 3 months.

As previously indicated, hens should not be culled on the basis of yellow in the front of the beak or in the shanks alone. The color change in these parts is so slow that the immediate production activity of the hen is better indicated by other characters (page 7).

A hen with very yellow beak and shanks ordinarily has not been laying very heavily for several months.

The beak may be used to tell what a hen has done within a month or 6 weeks. Several combinations of pigmentation are possible.

(*a*) A beak that is yellow part of the way out from the corner of the mouth and light beyond to the tip (Fig. 19*F*) shows that the hen laid enough to bleach the beak entirely but stopped laying recently.

(*b*) A beak that is light part way out and yellow the rest of the way (Fig. 19*C*) indicates that the bird has been laying after a long rest period.

(*c*) A band of yellow around the beak, with light color at the tip and near the base (Fig. 19*D*) shows that the hen has had a period of rest or a vacation recently.

(*d*) A band of light color, with yellow at the tip and at the base, shows that the bird began laying after a long rest, but has recently gone out of production.

(7) *Conditions affecting pigmentation.* The kind of feed given influences the condition of pigmentation. This fact must always be taken into consideration. Birds on grass range, or those fed a large amount of yellow corn, bleach out more slowly than those kept on bare ground or given feeds which contain small amounts of pigment, such as white corn, buckwheat, and skimmilk.

Thickness of skin affects pigmentation. A heavy, coarse skin bleaches out more slowly. The larger bird usually bleaches more slowly than the smaller bird.

The vitality of the bird is a factor. If ill, a hen frequently has little or no color. In this instance the absence of pigment is due to a failure to make use of pigment rather than to having laid it out. A strong, deep color is an indication of vigor. A naturally pale individual is less likely to have the staying power needed by a high-producing bird.

B. Molt. Molting is the act or process of shedding and renewing feathers. Hens usually molt in the following order: neck, breast, body, tail, and wing. Pinfeathers usually denote a vacation or at least a slacking up in production.

Birds inherit the tendency to shed their plumage annually. An early molter, under normal conditions, is a poor layer. A late molter, under normal conditions, is a good layer.

Hens seldom lay and shed feathers at the same time. A high-producing bird may, for a short time, molt and lay simultaneously; but usually she sheds more rapidly, and is declining in production when molting begins. When her wing feathers commence to drop, it is a sign that she is nearly or quite through laying. The fact that a hen sheds rapidly, though early, stamps her as being better than the common early molter that sheds slowly.

Molting and ceasing to lay indicate that a bird is going out of good physical condition. Presumably, a hen does not stop laying because she molts, but rather molts *or stops laying* because her physical condition is such that she cannot support egg production and continued nourishment of the feathers.

Whether the cessation of production or the dying of the plumage occurs first depends probably upon the inherited tendency and the physical condition of the bird. If the bird has an inherited tendency to high production, molting probably will precede cessation of production. If the bird has an abundance of vitality and an inherited tendency to low production, a cessation of production probably will precede molting. The body of the bird follows the line of least resistance.

Heavy production beyond the normal strength of the bird, improper rations, irregularity of feeding, low vitality, and an

inherited tendency to low production are conditions which may cause birds to molt before the normal time. Certain foods that are especially favorable to egg production and growth, the lengthening of the normal day by artificial light in connection with stimulating rations, and an inherited tendency to high production are likely to cause the birds to continue production and consequently to postpone molting beyond the normal period.

Any program of selecting birds for production on the basis of the molting factor must take into consideration the environmental conditions and the time of hatching, and must not depend exclusively upon the molting of the birds at any particular fixed season of the year.

In general it may be said that there are three kinds of molters in the birds hatched during the *usual spring season:* early, medium, and late.

(1) *Early molter.* The early molter, or the bird that ceases to lay in June, July, or early August, shows that she has a short laying period, that she probably started late and lacks the vitality, laying capacity, or inherited tendency to continue.

The early molter sheds and grows feathers so gradually that a person may not observe the process unless the bird is handled. She is not only very slow in molting, but as a rule she is very slow in production, having a shorter laying period and laying fewer eggs per week than the late molter.

The early molter seldom completes her molt in less than 3 or 4 months. She then rests for a short time and frequently does not get back into production any sooner than, and generally not as soon as, the hen that does not start to molt until several months later. In brief, she takes a longer vacation and should be culled.

(2) *Medium molter.* Birds molting during late August or September are termed medium molters. If artificial illumination is to be used, birds molting in September may be segregated, allowed to recuperate under favorable conditions for renewing their plumage and recovering their body weight, and

placed under lights in October after about 4 weeks of non-laying if to be held another year; otherwise cull them.

(3) *Late molter.* A hen molting in October or later is termed a late molter (Fig. 20). The feathers are dropped rapidly, and in a short time the plumage appears rough. There may be a few old feathers clinging to the bird, and her body will soon be covered with pinfeathers. Hens are rarely seen during July or August in this ragged condition. While molting, the late molter is quite timid and dislikes to be handled. This is due to the active circulation and sensitive nerve development in the feather follicles while new plumage is being grown. At this time the slightest touch hurts the bird.

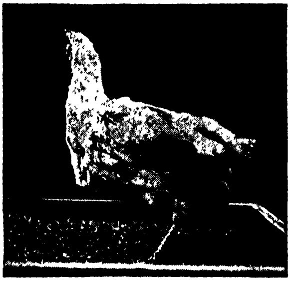

Fig. 20. Characteristic appearance of a late molter growing feathers rapidly.

The feathers grow in rapidly, so that the molt is over and the bird is back in production as soon as the early molters, or before most of them. Such a molt indicates that the bird has high vitality and therefore usually is a superior producer.

Illumination after 4 weeks of non-production is advantageous if birds are held as layers or breeders.

(4) *The wing molt.* (*a*) *Primaries.* Because the wing primaries are molted in a certain definite order, they show how long it is since the bird stopped laying. This frequently proves valuable as a check upon the pigmentation of the beak and shanks, or as a factor by itself.

Each wing usually has 10 primaries (Fig. 21). Leghorns nearly always have 10, but the heavy varieties occasionally have 11. Very rarely, 9 are found.

Order of shedding wing primaries. The primary next to the axial is the first one dropped (Fig. 21, Feather No. 1).

It seems a precaution of nature that the wing to be used, if needed, as a means of escape should never be without

feathers. As a result, these quills are shed in regular order, about 2 weeks apart in the case of an early molter. Since the new quills start to grow immediately, and it requires 6 weeks for one to grow to its full size, it will be seen, on an early molter, that when the fourth feather is shed a new full-grown feather will be in the place of the first one shed (Fig. 22).

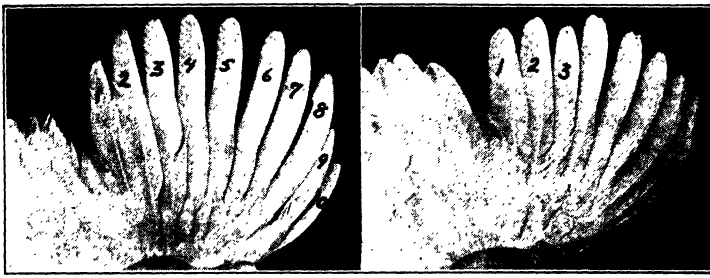

FIG. 21. *Left:* Note the ten primary feathers on the outer part of the wing. The short feather *A* between the primaries and secondaries is the axial feather. *Right:* The third feather from the axial feather is not full grown, denoting that three primaries were shed but that molting ceased at that point, perhaps at the time a resumption of laying occurred.

Assuming that the hen stopped laying when the first quill was dropped, we can, by allowing 6 weeks for the first feather, if full-grown, and 2 weeks for each additional full-grown feather, arrive at the approximate date when the hen stopped laying. Thus, the first 2 feathers being new and full-grown show an 8 weeks' molt (Fig. 22); 3 feathers complete, a 10 weeks' molt (Fig. 22); 4 feathers, a 12 weeks' molt; and so on. Counting in this manner for the 10 feathers, we find that 24 weeks are required to complete the molt (Fig. 22). This, however, presumably does not occur except in rare instances and in the case of birds whose vitality and production are very low.

The late molter may drop 2, 3, or even 4 primaries at about the same time, so rapidly does she molt. In this case, all the feathers dropped at the same time should be counted as one feather.

If a hen drops out of production during the summer because of adverse conditions, she often drops one or more primaries,

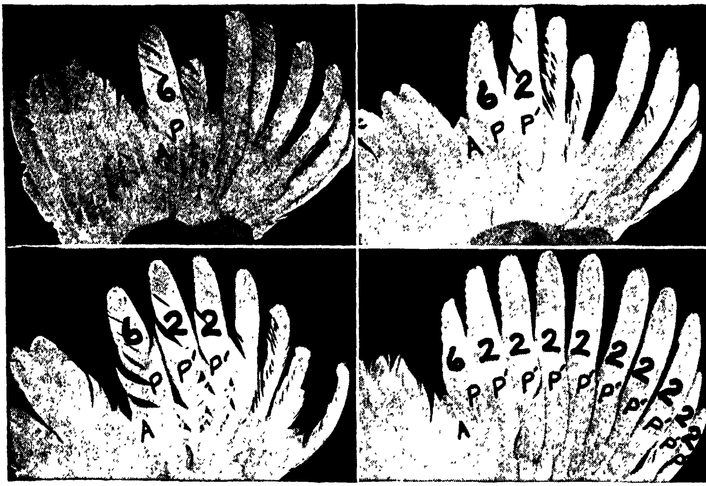

FIG. 22. Egg production indicated by the length of time of molting as determined by the shedding of the primary feathers. It takes about 6 weeks to renew completely the primary feather *P* next to the axial feather *A* and an additional two weeks for each subsequent primary feather *P′*. Photographs taken on December 4.

Upper Left: A 6-week molt. (Primary feather next to axial feather renewed.) Estimated date stopped laying, October 23. Second year record, 186 eggs.

Upper Right: An 8-week molt. (Two feathers completely renewed.) Estimated date stopped laying, October 9. Second year record, 164 eggs.

Lower Left: A 10-week molt. (Three feathers completely renewed.) Estimated date stopped laying, September 25. Second year record, 121 eggs.

Lower Right: A 24-week molt. (Ten feathers completely renewed.) Estimated date stopped laying, June 21. Second year record, 75 eggs.

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then stops molting and resumes production. This is known as a "vacation" molt, and not a regular molt (Fig. 21—right). Fortunately, when she goes into the regular annual molt, she will drop the next feather in sequence and molt in regular order

the remaining primaries. Then she may start back with the primary next to the axial feather and molt again those which had been renewed during her vacation molt.

When a break in the lengths of the primaries is noted, we know that the bird has taken a rest period. If the vacation occurred recently, it can be verified by the appearance of the beak. If all the feathers of this "vacation" molt are full grown, it is not possible to tell just when the hen took the rest.

The molt, therefore, assists in determining the length of laying period by showing when the bird stopped laying.

(*b*) *Secondaries.* Marble[1] reports the following order of dropping secondary feathers, counting from the axial feather toward the body.

11, 12, 13, 14, 10, 2, 3, 4, 5, 6, 7, 8, 9, 1 (Fig. 23).

Secondaries may be used as an aid in determining persistency as birds are through or nearly so before the secondaries are dropped. All birds may be divided into two groups, the first that continues to lay after starting to molt and the second group that ceases to lay after starting to molt. The rate of shedding primaries and secondaries in these two groups is:

Number Dropped during 4 Weeks after Molting Commenced

	Primary feathers	Secondary feathers
Birds molting while laying.......	2.1	0.45
Birds molting and not laying.....	4.2	6.6

C. Condition of the comb. The comb is a secondary sexual character. It tells what is going on in the ovary. It indicates the hen's reproductive condition, and enables one to judge whether or not she is coming into or going out of production, or is laying. If the comb is dry, hard, and scaly, the hen may still be laying but she will soon stop.

If the hen has been out of laying but the ovaries are expanded and she is coming back into production, the comb

[1] Cornell, 1928.

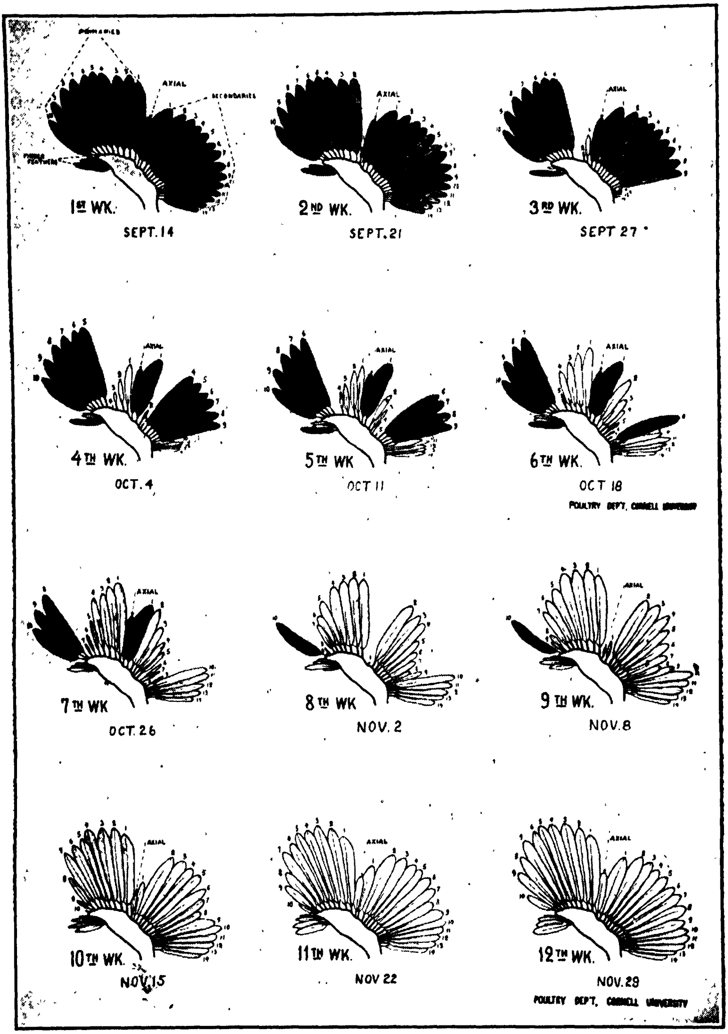

FIG. 23. The weekly changes in a normal wing molt. The primary feathers on the left are separated by the axial feather from the secondary feathers on the right in each of the twelve illustrations. The old feathers are shown in black and the new feathers in white. Cornell Ext. Bul. 175.

indicates the fact. It begins to swell; the blood rushes to the tips of the points, and they become hot, soft, waxy, brighter in color, and full. The white scale on the comb breaks apart and pieces of the red comb show through.

The comb is reddest and hottest just before laying commences. As soon as laying starts, the comb gradually cools and becomes somewhat lighter in color.

D. Condition of the vent. When a hen is laying heavily the vent is greatly stretched during the expulsion of the egg. It is therefore much larger than when she is not laying.

A hen laying eggs is much like a cow about to give birth to a calf, in that the vagina of the cow, or vent in the case of the hen, enlarges and the bones and muscular tissues in the immediate section spread to allow easy passage of the young, or the egg. The hen is in a continuous state of reproduction, i.e., of pregnancy, while in laying condition, and it is because of this that the large, moist, dilated, and oblong vent is found on the best laying hens.

E. Condition of the abdomen. When the bird is laying heavily the abdomen is much larger than at other times. The intestines and oviduct are expanded in the laying hen because they are distended and stretched by large quantities of food and by eggs. It has also been found that the heart, gizzard, crop, etc., are much larger in a heavy layer than in a poor layer.[1]

When the bird is laying heavily, the reproductive and supporting organs occupy a considerable amount of room, and they obtain additional room by pushing down the rear of the keel and pushing out the skin of the abdomen. Hence the full, soft feeling of the abdomen of a layer and the great depth between the pubic bones and rear of the keel (Fig. 24).

When the bird stops laying, the intestines are not so full, and the oviduct contracts because it has ceased to function. Hence, very little room is occupied by these organs, as, in

[1] Unpublished records at Cornell University.

addition, a smaller amount of feed and water is consumed. The pubic bones come closer together and become covered with fat; the rear of the keel springs back toward the pubic bones; and the skin lies in loose folds across the abdomen. Later the skin of the abdomen may become shrunken and tightly drawn (Fig. 13).

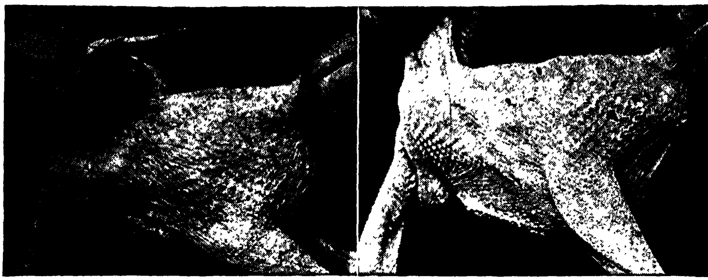

FIG. 24. *Left:* Poor layer. *Right:* Good layer. Note greater depth, back to rear of keel in the good layer.

2. Precocity

Precocity refers to a pullet's ability to lay her first egg at an early age. It is spoken of as early sexual maturity.

Early sexual maturity is inherited and is an index of the ability of pullets as egg producers, because pullets possessing it are likely to lay more eggs in a month and to continue to lay longer near the end of the production year. That is, early sexual maturity is often associated with greater *intensity* of production and more *persistent* production.

Precocity is a valuable factor but a less reliable index of inheritance of production than persistency, because it may be influenced by rearing conditions or by the management of the flock when placed in winter quarters.

Apparent early sexual maturity may occur when artificial illumination is used too soon on pullets. Pullets should come into production normally without the stimulating effect of illumination, that being resorted to only after the pullets are laying well and cold weather or other influences seem likely to reduce

the amount of feed the birds are consuming. This practice permits both physical and sexual maturity to proceed normally.

If sexual maturity is stimulated in the immature pullet by artificial illumination, the body size may be temporarily or permanently kept smaller. The egg also may be smaller, depending on the body size.

Precocity is best used in selecting pullets for egg production when desirable rearing and laying house management has permitted them to develop normally, without the retarding effect of crowding and wrong feeding or the stimulating effect of too early artificial illumination. The inherited ability of the pullet can then express itself better, and the flock can be selected by the operator more satisfactorily.

3. Season of laying as an indication of egg production

The following table[1] gives the results obtained with a group of fowls in a study of early sexual maturity or precocity and persistency.

To simplify the study, precocity is indicated by banding the pullets on the left shank with bands colored to represent the age at which each pullet started to lay. Persistency is indicated by banding on the right shank at the end of the laying year with bands colored to represent the approximate date the pullets ceased to lay.

In tabular form the plan for banding is:

Precocity		Persistency	
Banded on *Left* Shank		Banded on *Right* Shank	
Age at banding	Color of band	Date of banding	Color of band
6 months	Blue	Before September	Yellow
7 months	Red	During September	Green
8 months	Green	During October	Red
9 months	Yellow	After November	Blue

The chart on page 32 should be studied first for precocity, then for persistency, and finally for the two factors combined.

[1] Cornell data, 1916.

SEASON OF LAYING AS AN INDICATION OF EGG PRODUCTION

Results of Early Sexual Maturity (Precocity) and Persistency in 166 Birds Hatched in April and May, at Cornell University.

Laid 1st egg	Leg band, left shank	Number of birds	Ceased laying	Leg band, right shank	Number of birds	Production 1st year	Production 2nd year	Production 3rd year	Average
Before 6 months	Blue	4	(Layers), before September	Yellow	3	154.33	132.33	114.33	133.07
			(Breeders), after November 1	Blue	1	230.00	146.00	163.00	179.50
			Group Average	....	4	174.25	135.75	126.50	145.50
Between 6 and 7 months	Red	71	(Culls), before September	Yellow	22	124.45	110.91	99.23	111.53
			(Layers), during September	Green	18	154.44	138.78	117.44	136.89
			(Breeders), during October	Red	22	176.04	139.86	122.77	146.22
			(Breeders), after November 1	Blue	9	195.22	164.33	142.33	167.29
			Group average	....	71	157.01	133.72	116.60	135.78
Between 7 and 8 months	Green	50	(Culls), before September	Yellow	19	114.79	98.53	87.95	100.42
			(Layers), during September	Green	15	150.73	128.00	115.33	131.36
			(Breeders), during October	Red	11	100.18	142.82	130.36	144.45
			(Breeders), after November 1	Blue	5	161.20	139.80	122.40	141.13
			Group average	....	50	140.20	121.20	108.94	123.46
Between 8 and 9 months	Yellow	22	(Culls), before September	Yellow	18	98.06	116.33	106.78	107.06
			(Layers), during October	Red	3	146.67	136.33	119.00	134.00
			(Layers), after November 1	Blue	1	173.00	160.00	113.00	148.67
			Group average	....	22	108.09	121.04	108.73	112.62
After 9 months	No band	19	(Culls), before September	Yellow	10	76.20	91.50	75.60	81.10
			(Culls), during September	Green	6	81.83	122.67	110 00	104.83
			(Layers), during October	Red	2	115.50	116.00	110.00	113.83
			(Layers), after November 1	Blue	1	151.00	142.00	133.00	142.00
			Group average	....	19	86.05	106.58	93.10	95.24

First check precocity. The average egg production for each of the five groups based on their age at first egg is 174, 157, 140, 108, and 86. Those starting before 6 months averaged most eggs, and those beginning to lay after 9 months averaged 86.

Each group averaged less than the preceding group in a rating based on precocity. Improvement in production ability resulting from breeding and from better environmental conditions would likely show higher individual records today. The relative performance of precocious and persistent birds, however, remains the same.

The most persistent birds are those laying after November. In the first group is one such bird that laid 230 eggs. She also was one of the first to start; therefore, whether the rating was based on *persistency* or *precocity,* her superiority would have been recognized.

In the second group, 9 birds were laying after November. These averaged 195. In the third group, 5 averaged 161. In the fourth group, one laid 173; and, in the last group, one laid 151.

All these most persistent birds were good layers. The birds banded with red, those ceasing to lay in October, were better in nearly every case than those banded with green, which stopped laying a month earlier.

If all birds ceasing to lay before September 1 had been culled, only 3 good birds (first group) would have been culled. This speaks well for *persistency.*

If all birds that started to lay before they were 9 months old had been retained as pullets, there would have been a number of rather poor layers. This indicates that precocity is a less reliable guide than persistency.

A combination of the two, however, gives the correct length of laying period and provides a fairly accurate means of culling.

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CHAPTER III

HOUSING THE LAYING AND BREEDING STOCK

Operations:

1. Preparing the houses for winter.
2. Placing the birds in winter quarters.
3. Operating the house during fall and winter.
4. Deciding between single- and multiple-story laying houses.
5. Constructing a laying house.
6. Installing poultry house fixtures.

1. Preparing the houses for winter

A building that is to be used for the winter housing of poultry, and that has been occupied the previous year, needs some very important preparations for the reception of the new flock which is to occupy it.

A. Insure a parasite-free and disease-free house. With hoe and broom, scrape and sweep clean the interior fixtures. Scrape the nests, droppings boards, equipment, and floors free of all material. Sweep the ceiling, walls, windows, equipment, and floors of cobwebs, dust, and other debris. Remove the dirt and litter thus accumulated. If water pressure is available, use a hose to wash the complete interior and sweep out the surplus water. Allow the moisture to dry out partly and then spray the complete interior with any approved disinfectant. (See Spray Materials.) (*As this edition goes to press, the use of litter a second year is gaining favor, experimentally and practically. Thick clumps are removed, but the dry pulverized material is left. This practice is not recommended if disease was a problem.*)

Spray all fixtures thoroughly or dip them into a tank or receptacle containing the disinfectant. Scalding water is one of the most effective disinfectant agents.

Then paint the roosts and nests, making them mite-proof. One of the best materials for this purpose is carbolineum.

Apply carbolineum with a brush, painting perches, supports, and the inside of the nests. These should be allowed to dry for at least 24 hours, before they are occupied by the birds, to avoid injury due to blistering the skin or breathing the fumes. Care must be exercised by the one who applies carbolineum to avoid irritation to the eyes, nose, and hands. If carbolineum cannot be secured, apply some good coal-tar disinfectant, full strength.

When the house is kept clean as outlined in this chapter, the amount of work required for cleaning at any one time is very much reduced.

B. Provide interior fixtures for laying, eating, drinking, and resting.[1] Each 100 layers should have, in lineal feet, approximately the following: *nests,* 20; *mash* feeding space, 24, *grain* feeding space, 24; *shell* feeding space, 4; *grit* feeding space, 1; *perches,* 60 for light breeds and 70 for heavier varieties. (*Night droppings* may fall on boards, into pits or on the floor litter.)

In addition, provide one *watering pan* 18 inches in diameter if a continuous flow of water is available or if a float valve can be used. Otherwise, a trough to hold a day's supply of 7 gallons of water is needed.

Install one *light* for each 200 square feet of floor space—15-watt lights for all-night use, or 40-watt lights for 13 or 14 hours of daylight and electric light combined.

C. Repair and clean windows. If cloth curtains are used, repair them if necessary with cheesecloth or muslin.

[1] A more detailed discussion will be found in a later section. These directions are given here in order that the house may be put in shape quickly and the necessary equipment installed.

Glass windows should be repaired, cleaned, and stored until cold weather arrives.

D. Provide proper litter and nest materials. Put 3 to 4 inches of clean litter on the floor and add more from time to time as it becomes well broken, until it is 6 to 8 inches deep. The common straws for litter, in the order of their desirability, are wheat, rye, oat, and buckwheat. Shredded or cut cornstalks or shavings may be used if straw is not available. Straw or cut cornstalks mixed with shavings make a fluffy, loose litter. The ideal litter is one which is durable, does not pack readily, and permits moisture to evaporate quickly. Leaves pack, and therefore they are less desirable.

Be particularly careful that the litter used is free from mustiness, mold, or decay, as serious trouble may develop in a flock where this precaution is not heeded. (See page 231.)

Nesting material should consist of 4 to 5 inches of shavings, oat or buckwheat hulls, or cut straw.

The house should now be ready for the birds. If the back, roof, sides, and floor are tight, and the front permits a good circulation of air without draft upon the birds, it should be comfortable.

2. Placing the birds in winter quarters

Allow 3 square feet of floor space per bird for Leghorns and other light varieties and 4 square feet for heavier varieties. The use of *range* for laying pullets or hens is being abandoned by commercial poultrymen with flocks of 300 or over. Smaller laying flocks are generally not commercial and often not confined.

When the first pullets commence to lay, all the promising, vigorous birds with combs of essentially similar development should be placed in permanent laying quarters. There the pullets should continue their development and come into production with no setback because of changes in environment or management. Pullets should not be put in and confined to the houses too early, as they will develop better while on range;

nor should very many be laying before they are put in unless nests similar to those in the laying house have been provided on the range. A change in type of nests and method of feeding and environment may check production and a partial or complete molt may follow. House the large, the average, and the undersized pullets separately, when possible, until all have reached a similar appearance.

The guides that help to determine the time to move to winter quarters are (*a*) laying maturity and (*b*) climatic conditions.

(*a*) The age at which pullets begin to lay will vary with the region, the season of the year, the altitude, the method of feeding, the variety, and the strain. It will usually occur between 5 and 7½ months. Comb development is one of the best guides.

(*b*) Pullets should be well settled in winter quarters before very cold weather arrives.

Give ample food. Pullets continue to grow for several months after laying commences. Feed both grain and mash in hoppers for 2 to 4 months at least.

It is good practice to mark a dozen pullets in each house with leg bands or paint and weigh and record the weight of the same birds every 2 weeks as a guide to the condition of the flock.

If pullets are not gaining in weight or at least maintaining their weight, feed a moist mash or pellets or extra grain in the litter.

Control lice and mites. Range pullets and cockerels should be free of lice and mites and remain so if the house is properly prepared (pages 35 and 36). Blue ointment, sodium fluoride, or Black Leaf 40 is recommended, if needed, for lice (pages 253 and 254).

3. Operating the house during fall and winter

The main points to watch in either single- or multiple-story houses are cleanliness, dryness, and purity of air.

A. Clean out the droppings. (See page 268.) Floor litter needs renewing only once annually, providing it is reasonably

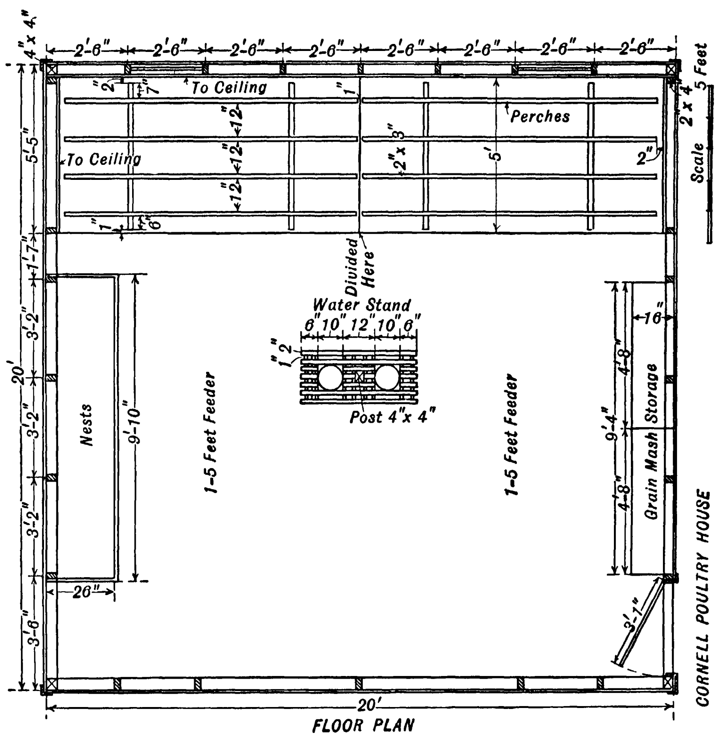
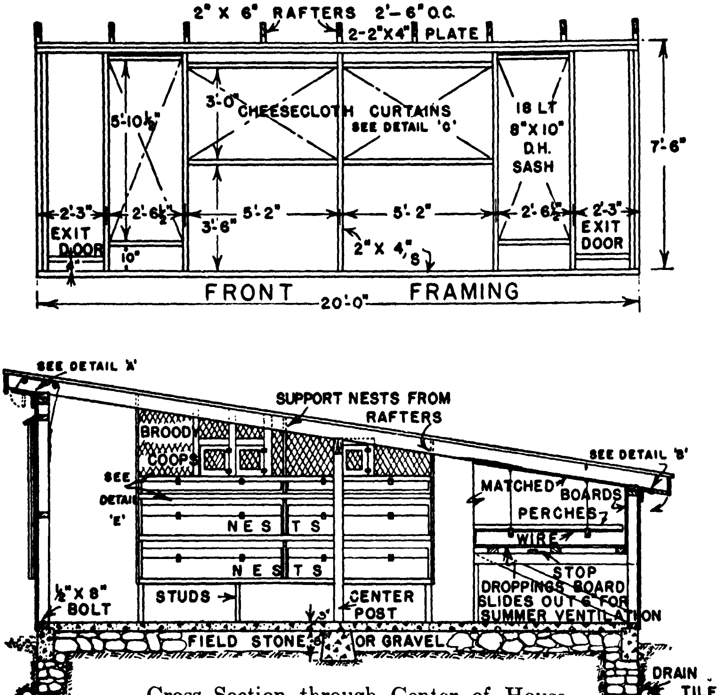


FIG. 25. The Cornell laying house with units 20′ × 20′. This house is adapted to flocks of 100 or more. Several units may be connected to hold 500 to 1000 birds, in which case the partitions may extend entirely across the pen, or two-thirds or three-quarters of the way as desired. Perches may extend lengthwise as shown here or cross-wise as in Fig. 26.

clean and dry. Damp litter is less objectionable to laying than commonly thought, but it may harbor and spread certain diseases. Wet litter should be avoided. Dryness reduces labor in cleaning houses and eggs.

B. Change the air. Leave the houses open in the front for *several weeks, if possible, in order to continue range open-air conditions.*

For single-story buildings the rafter outlet type of ventilation similar to that shown in Figs. 27 to 30 is desirable.



Cross Section through Center of House.

FIG. 26. 20′ × 20′ Cornell laying house. Note location of drain tile and construction of foundation and floor.

As cold or windy weather approaches, close both front and rear ventilator boards and put the windows in place. The shortened ventilator board (Fig. 27*c*) in front insures an air outtake when the board is raised. On days when storms blow into the house or the temperature approaches zero, it may be necessary to close the curtains for a short time. At all other

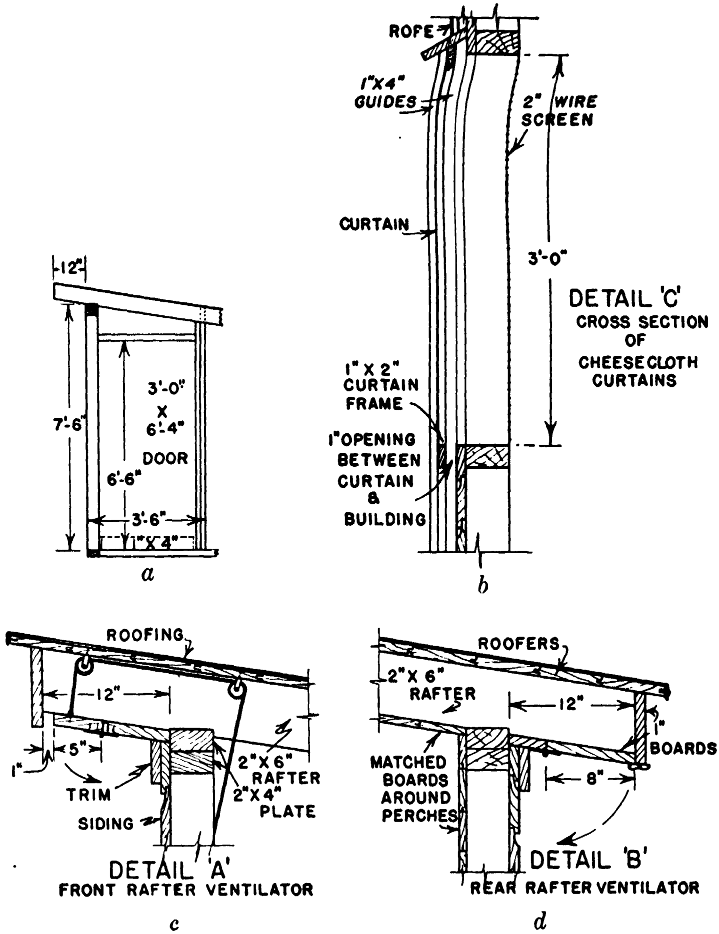
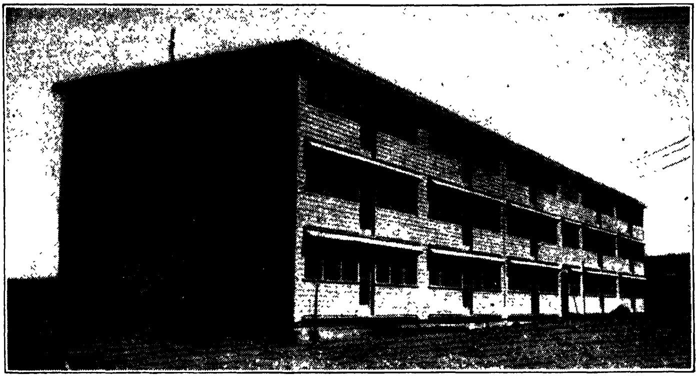
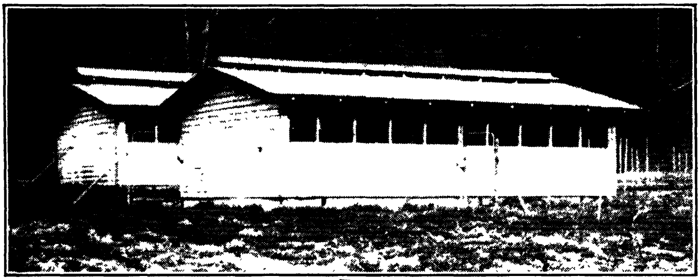


FIG. 27. 20′ × 20′ Cornell laying house. *a,* door framing detail; *b,* the curtain is set away from the house 1 inch—this leaves an inch opening at the bottom for an air intake in a tightly constructed house; *c,* the front ventilator door should be open in summer, but in winter it may be closed, as the 1-inch opening provides sufficient outtake; *d,* the rear ventilator door should be closed in winter and opened in summer.



A.



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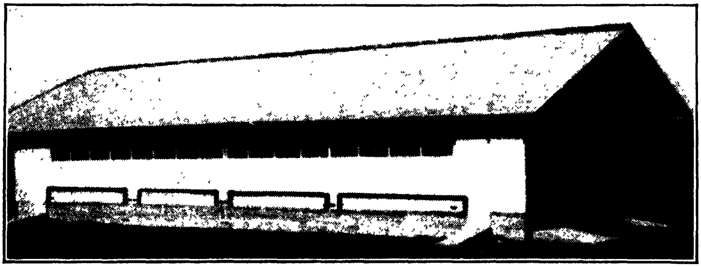


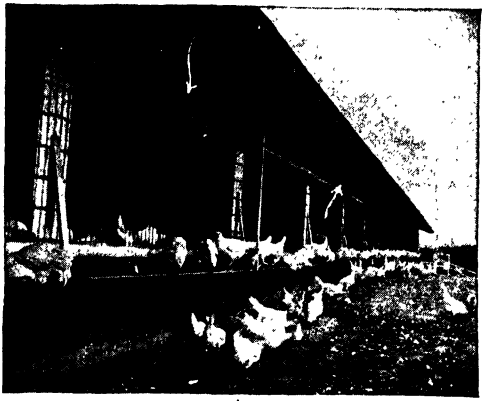
C.

FIG. 28. Types of laying houses in the United States.

A. A flat-roof multiple-story poultry house in Connecticut. The roof is "built-up." The walls are well insulated. The outtake is at the top of the windows. The intake moves air up between the outside and inside walls and into the house just below the windows. Designed by Prof. Roy E. Jones, Univ. of Connecticut, Storrs, Conn.

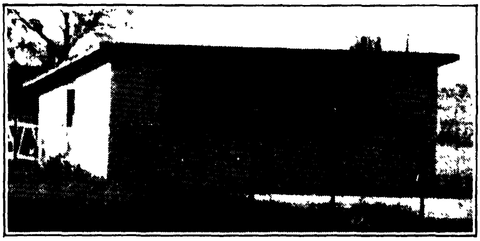
B. The Florida gable roof, open-front laying house with peak ventilation. Door ventilators are also placed at the rear of the building just under the plate or below the droppings board, or both. Courtesy Prof. N. R. Mehrhof, Univ. of Florida, Gainesville, Florida.

C. 20′ × 40′ straw-loft laying house used in Louisiana. Overhanging roof and ventilator doors near floor and on the end give protection from heat. Insulation is recommended against dampness and heat. Photo courtesy Dr. Chas. W. Upp, Louisiana State Univ., Baton Rouge, La.



A.

B.



C.

FIG. 29. Types of laying houses in the United States.

A. A type of front in Washington. Note the rolled curtain which may be dropped, if desired.

B. 24′ × 24′ laying house, designed for warm climates, in use at the Texas Agricultural Experiment Station. Note numerous floor openings and sun protection. Courtesy Ross M. Sherwood, Chief, Division of Poultry Husbandry, College Sta., Texas.

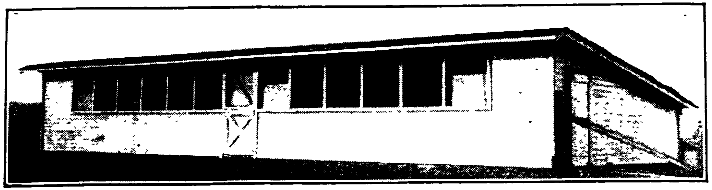
C. Adobe houses with high open front are adapted to farm flock use in New Mexico. Often used with double yard system, barren in one yard, green in the other. Courtesy Prof. L. N. Berry, New Mexico State College of Agriculture and Mechanic Arts, State College, N. Mex.

A.

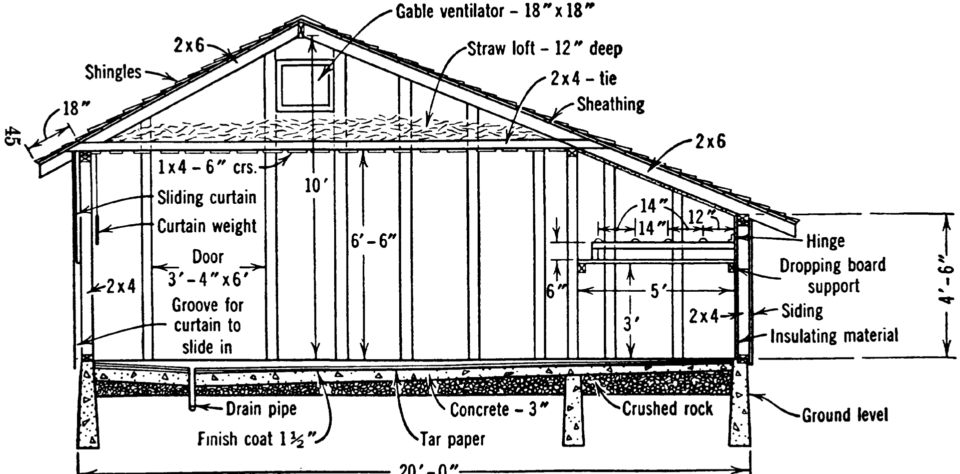
B.

FIG. 30. Types of laying houses in the United States. *A*. 20′ × 20′ straw-loft two-unit house for 200 hens, used in Illinois. Straw affords low-cost insulation and helps maintain moderate and fairly uniform temperature. Courtesy Dr. L. E. Card, Univ. of Illinois, Urbana, Ill.

B. Kansas 20′ × 70′ straw loft house with 10′ feed room is the desirable 300 hen unit on Kansas farms. The house provides protection from strong winds, blowing rain or snow, and intense heat and cold. One square foot of open front with sliding muslin curtain to each 10 to 12 square feet of floor space is allowed. Courtesy Prof. L. F. Payne, Kansas State College of Agriculture and Applied Science, Manhattan, Kan.



A.



B.

FIG. 31. Types of laying houses in the United States. *A*. Colorado shed-roof commercial laying house, 24′ wide for 500 hens. The high front openings are equipped with sliding muslin curtains, which when closed leave an air exit above and an air intake below each curtain. A baffle board is placed at the intakes. See page 85. Courtesy Dr. H. S. Wilgus and Mr. O. C. Ufford, Colorado State College, Fort Collins, Colo.

B. Montana 20′ × 20′ unit combination roof, straw-loft type house, with high sliding front curtains. Courtesy Miss H. E. Cushman, Montana State College, Bozeman, Mont.

times, leave the curtains down. This should allow plenty of fresh air and sunshine, provided there is sufficient cloth space for the size of pen and number of birds. (See page 96.)

The opening under the eaves in the rear is almost a necessity during hot weather (Fig. 27*d*). This opening should extend the full length. Both front and rear ventilators are usually kept open all summer and closed in winter.

4. Deciding between single- and multiple-story laying houses

Both types have their strong advocates. The decision may rest on climbing stairs versus walking on a level. Stairs should not be the narrow, steep kind too often found, but should be built with 6-inch risers and 10- to 11-inch treads. An elevator is necessary. Ceilings need not exceed 6½ to 7 feet above the floor, the height depending largely on how tall the operator is and whether a cleaning truck is to drive onto the first floor.

Barns may be remodeled and new structures built 36 to 40 feet wide or wider. Thus they will be interchangeable for other purposes if and when desired.

Other features of multiple-story laying houses are one roof and one foundation and a more compact structure, housing several times the number of birds on the ground required for single-story buildings. The cost per bird for ground and structure is reduced, although partly offset by heavier foundation, framing, an elevator, and stairways.

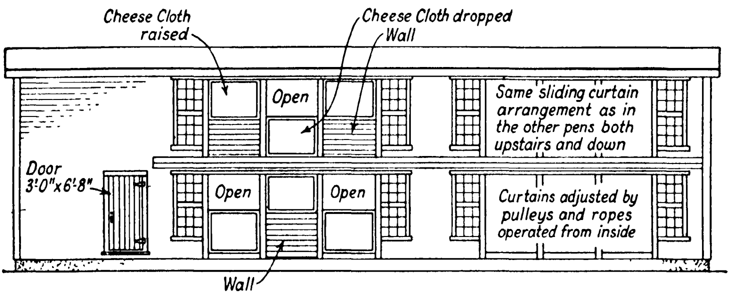
With this type of building, miles of travel in a year are less in caring for the same number of hens. Pen cleaning on upper floors may be through wooden chutes outside or canvas chutes inside leading into a truck on the first floor.

Less water pipe is required in extending upward 7 to 8 feet to each succeeding floor than in crossing the pens in long single-story houses. Electric heating cable can be used more economically and efficiently.

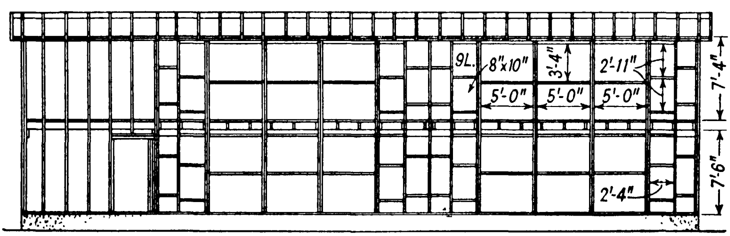
Flocks of only 500 to 1000 layers are best housed on one

floor. For larger flocks, the multiple-story house may be considered.

It is seldom that widths of less than 30 feet should be considered for multiple-story houses.



SOUTH ELEVATION



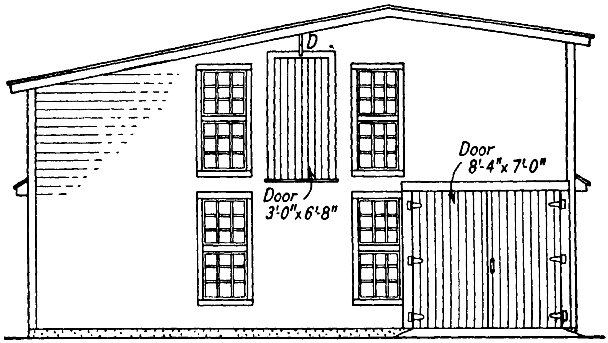
FRONT FRAMING

FIG. 32. Two-story laying house 30′ × 50′ with 12′ feed and storage room at end.

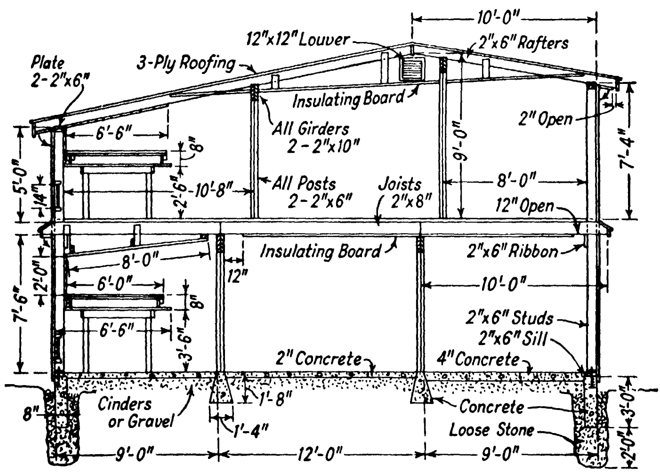
DESCRIPTION AND PLANS OF A TWO-STORY LAYING HOUSE (30 by 50 feet)

The plan for the two-story poultry house incorporates the ideas found in the standard Cornell 20 by 20 foot laying house and adapts them to the changes in width and ceiling.

The essential features are: provision for a driveway through the house which facilitates cleaning; the combination roof with shed-roof ceiling for the upper floor, providing economical



WEST END ELEVATION



CROSS SECTION
END ELEVATION

Fig. 33. 30′ × 50′ laying house. Provision is made for unobstructed air movement at the ceiling toward the front on both floors.

construction for the wide house, reduced air space, and proper vertical air movement; the front-rafter ventilation for year-around use and the rear-rafter ventilation for summer use; the perches perpendicular to the rear wall; the portable droppings boards which may be moved away from the rear wall for better summer air movement; the 12-foot storage room; and the nesting room.

The house is 30 by 50 feet, with a 12-foot storage room, making the entire building 30 by 62 feet. The capacity is 500 birds to each floor, or 1000 birds for the entire building. Several units for 1000 birds may be added.

The house should have tight windproof walls. A single layer of matched boards, then building paper, and finally clapboards or other siding makes a satisfactory wall.

For those desiring a better-insulated house, the wall construction described on page 84 may be used, with the same front construction shown in the plan, or the curtains may be replaced by sliding glass windows or other solid material. Construct the windows so they may be opened on good days, and provide intakes under the windows (page 85). Operate the outtakes at the ceiling as described for the 20 by 20.

Ten mash feeders, each 5 to 6 feet long, are needed on each floor, together with watering equipment.

The roosts are portable and rest on the droppings boards. Both are constructed in sections. If desired, the droppings boards may be removed and the perches lowered somewhat and suspended by chains or wires over a space on the floor $6\frac{1}{2}$ feet wide and as long as the perches. A plank on edge will confine the droppings to this space. No. 14, 15, or 16 wire netting may be used to cover the space.

The panel above the perches on the first floor should be fastened with screws. According to the location of the house, this panel in some instances may be placed flat against the joists instead of sloping as shown in Fig. 33, first floor. It is suggested that the panel be constructed as indicated and changed later if desirable.

5. Constructing a laying house [1]

A. Lay out the foundation. Locate a corner on the highest point of ground on which the proposed building is to stand, and about this corner drive 3 stakes, as *A–B–C* in diagram, Fig. 38, approximately 3 feet apart.

Guided by a spirit level, nail boards on these stakes as shown, with the upper edge just 6 inches above the ground at the corner *D*. With the steel square as a guide, lay a line from *F* to *E* which will be the direction of the desired frontage, and another line *G–H* which will represent one side. Measure off the desired length and width of the house on these lines, and drive stakes about the corners. By means of the spirit level and straightedge, determine the level at *E–I–H–J* and nail boards to the posts at this level. In the same manner, find points *K–L* on the other corner. Lines may now be stretched between these points. As an aid, when the points are far apart, stakes may be driven in at intervals and boards nailed on at the correct level, as at *M–n*.

The 6–8–10 rule will assist in checking the square corners. Measure 6 feet in one direction and 8 in the other. If the two points thus determined are 10 feet apart, the angle formed is a right angle (Fig. 38).

B. Construct the foundation. (Fig. 39*A, B, C, D*.) When digging the foundation trenches, dig below the frost line. This may be 15 or 18 inches in light soil, or 2½ to 3 feet in heavy soil. The width of the trench should be about 15 inches. A drain tile may be placed in the bottom of the trench and arranged to carry water out at the lowest level. Fill with cobblestones or cinders to within 6 or 8 inches of the surface. Tamp, if cinders are used. On this material place the forms for the concrete, making sure that the top of the form is level and coin-

[1] In the poultry enterprise the costs for buildings constitute a large percentage of the total poultry inventory. It is frequently desirable to remodel a shed, barn, or other building or a poultry house with too high a roof, which gives considerable trouble from dampness on the walls or in the litter, or which is otherwise unsatisfactory.

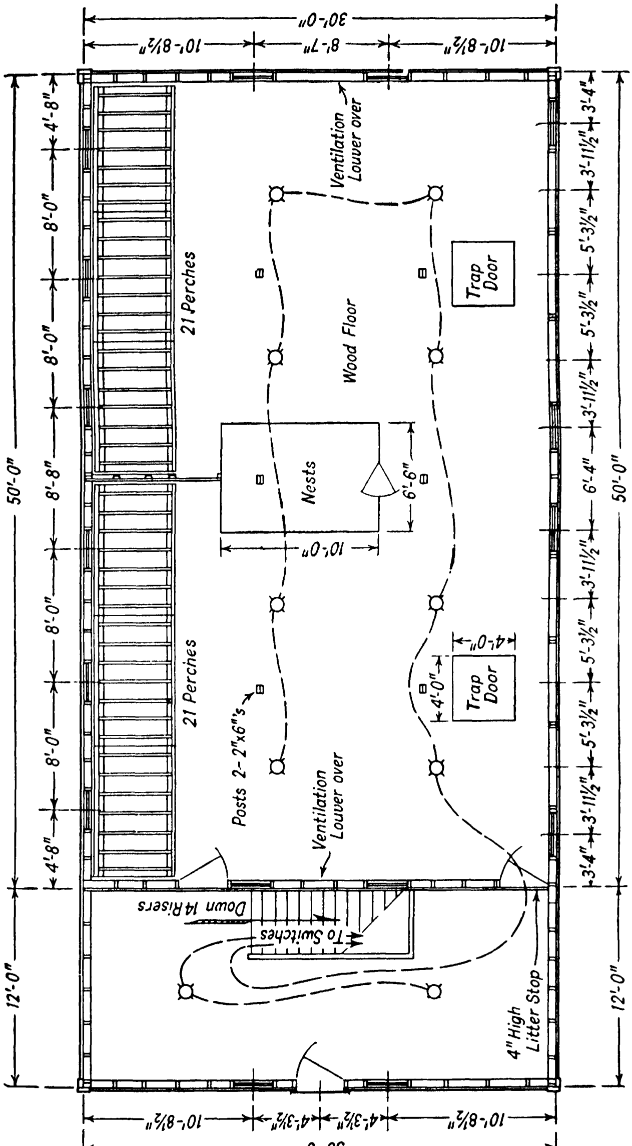


FIG. 34. 30' × 50' laying house. Second-floor plan. The first-floor plan provides for driving through on the inside from end to end.

cides with the lines as previously laid out. These forms should be 6 inches apart, inside measurement for single-story houses, or 8 inches for multiple-story houses. Fasten the forms at intervals to keep them from spreading after the concrete is poured. Nail cleats across the corners to prevent bulging.

Fill the forms with concrete.[1] While the concrete is still soft, place ½-inch by 8-inch bolts every 5 feet, with the heads down and extending about 3 inches above the concrete. These

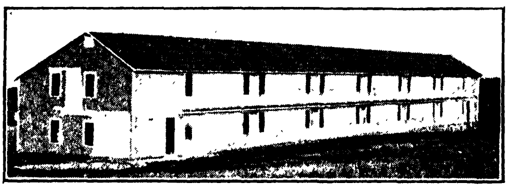


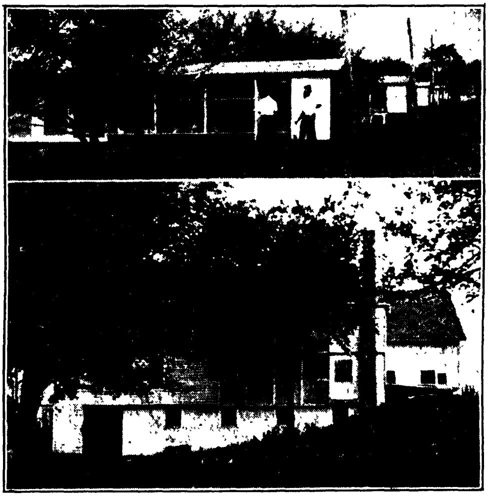
FIG. 35. A Cornell 30′-wide house constructed 150′ long, with a storage room at each end. Total length, 174′. Capacity, 3000 birds.

are to hold the sills in place. After 2 or 3 days, remove the forms and place on the foundation wall a 2 by 4 inch sill with holes bored in it to take the bolts. The outer edge of the sill should be flush with the corresponding edge of the wall. Fasten the sills down firmly with a washer and nut.

C. Build a floor. A concrete floor may be laid after the siding and roof are on, or before the framework is erected. Six to 8 inches of gravel or cinders should be placed below the floor and thoroughly tamped. Next a 2-inch layer of concrete should be added. (If there is danger of water rising through the coarse fill and the concrete to the surface of the floor, a layer of tar building paper or a thin layer of coal tar, applied hot, may be laid or spread over the coarse fill before the cement floor is added.) Stretch a string from sill to sill to indicate the height of the finished floor. Lay 2 by 4 or 2 by 6 inch pieces parallel to the side walls or to each other to make

[1] See Chapter IV, "Concrete Foundations," for kinds and amounts of material to use and method of estimating.

A.



B.

FIG. 36. Three methods of housing pullets and layers. *A*. A two-story house with the flue-type ventilation shown in Fig. 58.

B. Upper buildings hold 400 birds each, which are easily serviced by a truck passing along the road to the right. The lower method shows a barn remodeled for poultry, which is housed on two floors. An incubator cellar is in the basement. Both methods make prominent use of the open front.

FIG. 37. *A*. The barn shown in *B* before remodeling. *B*. Barn remodeled into a four-story laying house. Air intakes through curtain openings. Air outtake is in front at the ceiling as shown in Fig. 27.

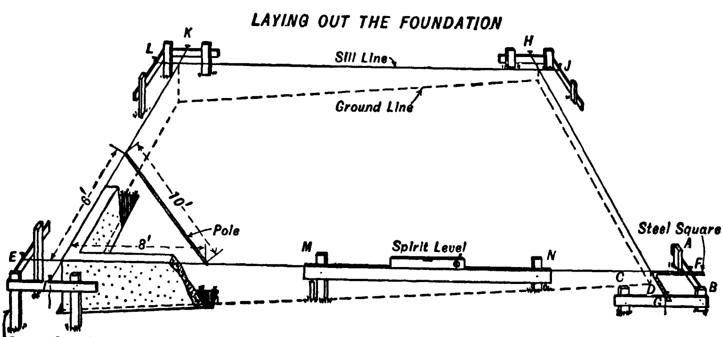


FIG. 38. Laying out the foundation.

sections 4 to 8 feet wide. Lay these flat and with the upper edge flush with the string. Brace the pieces firmly by driving stakes or by nailing, or both. Fill alternate sections with concrete the first day and the remaining sections 1 or 2 days later. Starting at one end, fill in a few feet of concrete. With a straightedge moving back and forth and, at the same time, slowly forward, keep the concrete level until the entire space is filled. Trowel the surface to make smooth.

6. Installing poultry house fixtures

The following points should be borne in mind in planning poultry house fixtures.

Convenience of the caretaker and birds. It is possible to place the fixtures where they will be convenient for the operator in doing the work and at the same time be excellently located for the hens. Convenience in operation means a saving in time and more efficient care. When work is convenient it is more likely to be well done.

Portability. Unless the fixture is very open and will permit practically all parts to be reached by spray materials, enough parts should be removable to permit the rest to be cleaned thoroughly.

Unobstructed floor space. If boxes, pails, etc., rest on the floor, the space for hens is reduced. Fixtures should be placed on low stands or racks.

Simplicity and economy of construction. The cost of the fixtures is a large item of expense. The simpler ones are less expensive and less likely to get out of order.

A. Perches. The perches are usually placed at the rear of a 20 by 20 or smaller house, parallel or perpendicular to the rear wall (Figs. 25 and 34). This permits a maximum amount of light on the floor beneath them when droppings boards are used. They are out of the way and in a protected position. In wider houses or pens they are often placed part way or completely to the center of the room.

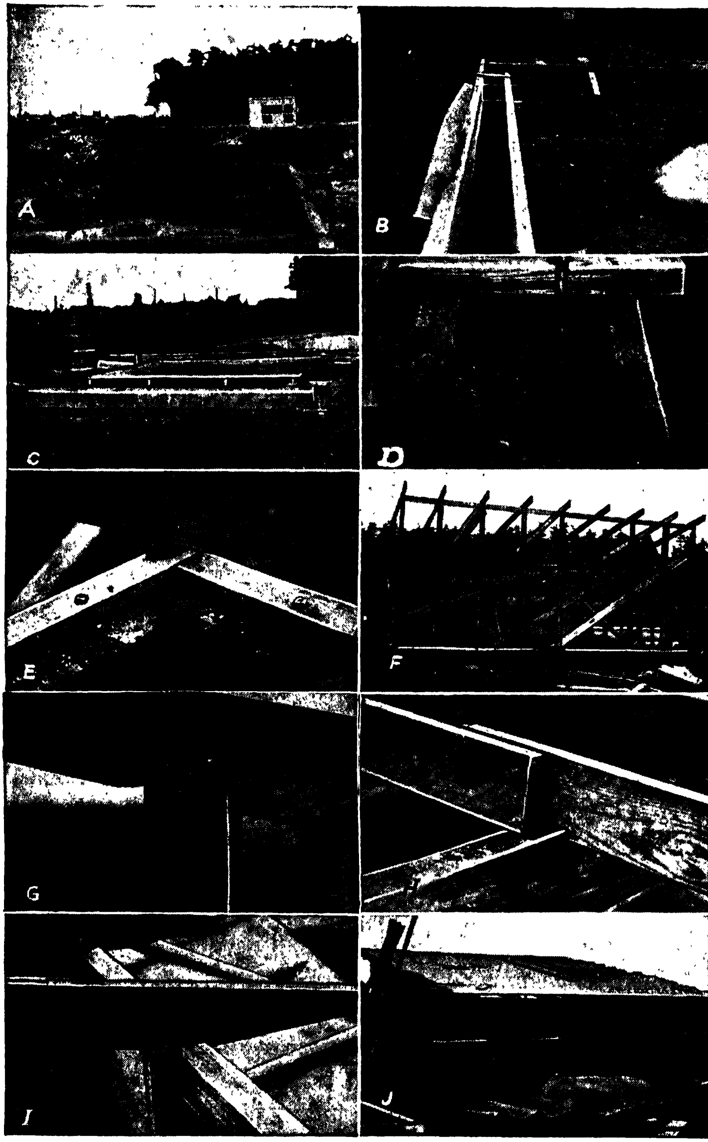


FIG. 39. (Legend on opposite page.)

FIG. 39. Constructing a laying house.

A, note guide timbers and trench. First operation is preparing for the foundation. *B*, trench partly filled with stones which act as the base for the wall. Part of the forms in place. *C*, a concrete mixing platform. Conveniently located for rapid placing of the concrete after being mixed. Water, sand, cement, and aggregate near by. *D*, a piece of a 2 × 4 may be used to determine the height the bolts should extend above the wall. Anchoring bolt placed head down while cement is soft. *E*, sills bolted to the wall and placed on the outer edge of the wall. Corner post erected. A second 2 × 4 will be added, resulting in a 4 × 4 for the corner post. *F*, framing nearly completed. *G*, note front plate on edge and stud cut to fit. Rafter is notched to rest squarely on the stud and plate. *H*, rafters resting on center stringer. Both rafters should project beyond the stringer, thus making stronger construction. *I*, note rear plate on edge and rafter notched to rest on plate. *J*, the roof boards are nailed on and the ends evened later by sawing along a chalk line.

FIG. 40.

K, roofing is laid from the rear toward the front. *L*, the front framework. *M*, a rear window opening and part of the roosting space ceiled. *N*, two-ply roofing paper laid on outside of the siding; aids in keeping the house warm in winter. *O* and *P*, the completed house, front and rear.

(1) *Distance and space required* (Figs. 25 and 34). Perches should be on the same level, or nearly so, and at least 8 inches above the droppings board if used. The rear perch should be 9 inches from the wall and the remaining perches 14 inches apart on centers. Birds of the Leghorn type require 6 or 7 inches of perch room; the heavier varieties need 8 to 12 inches.

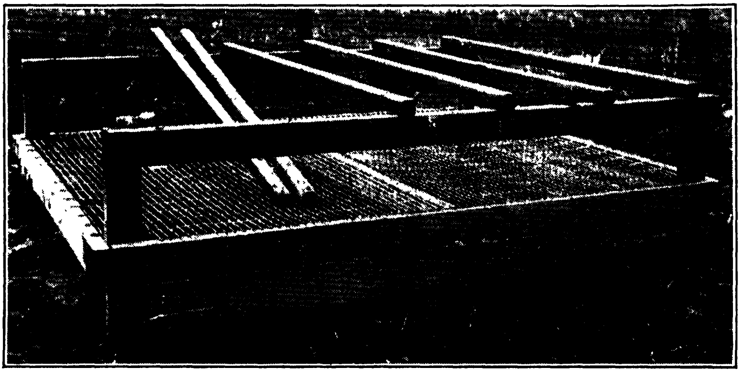


FIG. 41. Perch arrangement. A portable droppings pit and perches. Note the pins for holding perches in place. The 1″ × 4″ wire permits the droppings to fall through but keeps the birds from them. Rats may accumulate in this protected space unless they are watched carefully or cat holes are provided.

(2) *Material and construction.* For long perches, 2 by 3 or 2 by 4 inch material may be used, set edgewise and with upper corners rounded. For short perches use 2 by 2 inch pieces. Poles are sometimes used. They should be straight, stout, rounded, and about 2 inches in diameter.

To keep the birds from the droppings, No. 15 or 16 gauge 1½-inch mesh wire may be fastened beneath the perches.

B. Droppings boards may be removable and in sections or in units complete with perches. They should extend 6 or 7 inches beyond the outer perches. Place the boards perpendicular to the side, thus making them easier to clean, and 2 to 2½ feet above the floor.

Droppings may fall directly onto the litter, on a concrete

A.

B.

FIG. 42. Perch arrangement. *A*. Units 8′ × 6′, perches 14″ on center, and droppings boards 1½′ above the floor. Material may be cut without waste. Perches are 2″ × 2″ × 8′, five to each unit. May be placed end to end and against the wall or away from it. Easy to move.

B. A series of roosting units consisting of frames for supporting the perches. Droppings fall to the floor. The birds keep the surface scratched over and, if desired, a few forkfuls of litter may be scattered over the droppings occasionally. This represents a cheap roosting arrangement. Ordinarily no increase in the number of dirty eggs is noted.

Note double-deck feed hopper at right, 8″ deep, 8″ wide, and 5′ or 6′ long.

floor, or into a pit from which the birds are excluded. Ease of cleaning may be a determining factor in deciding which is best.

C. Partitions. Partitions are needed in single-story houses in the northern section of the United States. They prevent

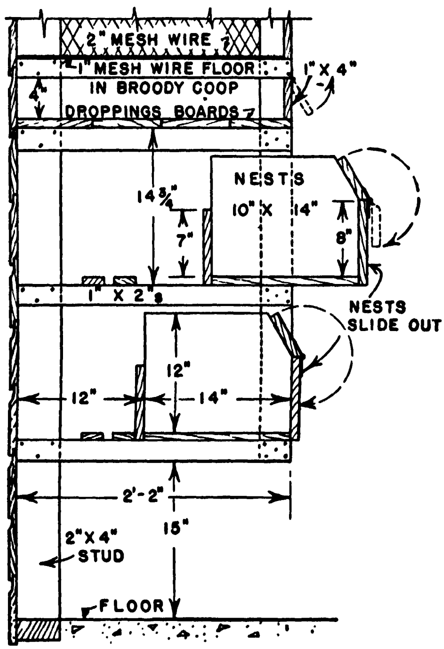


Fig. 43. 20′ × 20′ Cornell laying house. A convenient and serviceable nest and broody coop combination.

the wind from sweeping along the perches in long pens with open or curtained fronts. The partitions should extend from the floor to the ceiling and from the rear forward to a point about 1 foot beyond the edge of the droppings board, and not more than 20 feet apart.

D. Nests. At least one nest to each 5 layers is needed during the heavy laying season.

Nests should be roomy, easily cleaned and serviced. Nest

partitions may or may not be used, as desired. The birds appear to use the small nest or the long box (4 or 6 feet in length) equally well. Nests preferably should be slightly darkened.

(1) *Size* (Fig. 43). Nests should be about 12 inches square and 6 or 7 inches deep.

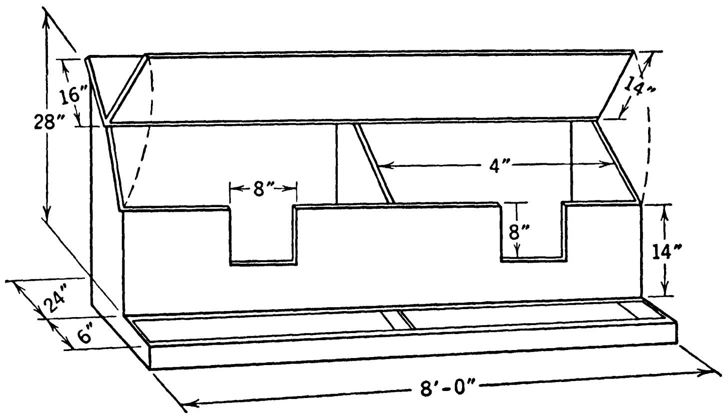


Fig. 44. Tunnel colony nests. Adaptations of community nests have been used occasionally for many years. Recently a nest developed by a poultryman and called the Massachusetts Clean Egg Nest has been publicized. The entrance opening 6 inches above the nest floor keeps nesting material in place. The front half of the top is hinged for easy egg gathering. The two sections have an area of 2′ × 4′, with but one entrance to a section, and will accommodate 75 to 90 birds, depending on the breed.

(2) *Location.* To save time in gathering eggs, locate nests either against walls or partitions, or build a nesting room.

Nesting rooms are practical for a flock of 200 or more birds. They are convenient for gathering eggs, cleaning and refilling nests, and are freely used by the layers which enter the nests from inside the nesting room. Eggs are gathered from the inside of the nest room at considerable saving of the operator's time; 3 or 4 tiers of nests for light breeds and 2 or 3 for heavier birds are used.

(3) *Means of closing.* Prevent pullets from roosting on the edge of the nest or birds from entering it, when one is trying

to catch them, by placing a sliding door on the entrance ends, or by closing the doors into the nesting room (Figs. 43, 45, 47).

(4) *Trapnests.*[1] The trapnest is designed to trap or hold the bird in the nest until the attendant releases her. Usually

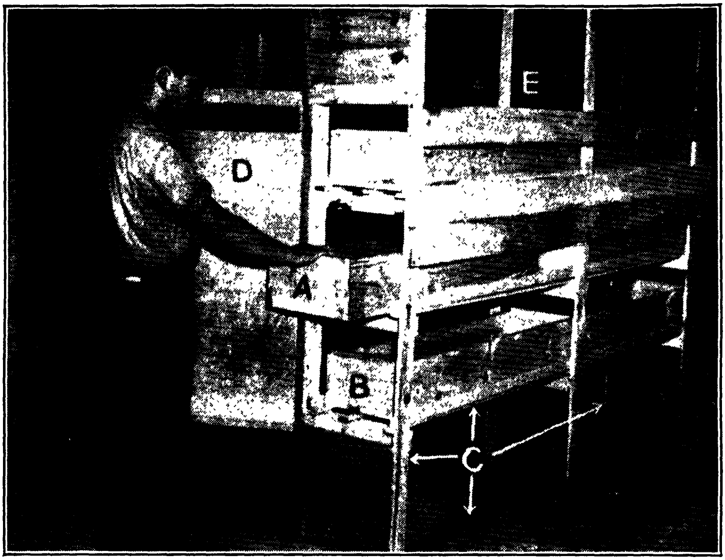


FIG. 45. A nesting room being constructed. The completed room is shown in Fig. 47. *A* and *B* are trough nests 4′ long and without partitions. Opening door *D* permits troughs to be removed for emptying, renewing nest material, or placing floor eggs in the nest. *C* will be equipped with an entrance door for the layers. *E* is the operator's entrance from an outside room. Note the siding which overlaps the bottom of the upper trough and the top of the trough next below. Since the trough slides inside the uprights, provision is made for some light and air to enter between the trough and the siding. Note the support for troughs also to the left.

the bird releases the door either by her weight or by lifting the door slightly with her back as she enters, thus letting a trigger drop away, allowing the door to fall in place or dropping part of the door itself. This prevents other birds from entering and

[1] For the use of trapnest in pedigree work, see Chapter XIX.

the layer from escaping. A daily trapnest record, if kept, shows which hen lays each egg and is of great value in pedigree breeding. The operator can keep well informed as to the weight of his birds through constantly handling them.

E. Broody coop. Usually it is well to provide each pen with one broody coop, as it is needed to break up broody hens (see page 513), to hold surplus stock when culling, or to hold injured or sick birds until the attendant can care for them. The coop may be of wire or slats with a bottom of 1-inch mesh wire or slats. A platform beneath the bottom, to catch the droppings, is desirable.

Fig. 46. Inside of the nesting room. Trough sides are 8″ high, thus permitting ample nesting material.

As most broodiness occurs during the warmer part of the year, light, airy quarters are desirable.

Coops or pens in the house or near by are frequently used, but should be located where the least amount of walking is required.

F. Feed hoppers (see Fig. 42*B*). The ideal dry-mash hopper is one combining 4 points in addition to the general essentials for all fixtures mentioned on page 55.

It should:

(*a*) Hold several days' supply.

(*b*) Provide a constantly available supply.

(*c*) Prevent waste.

(*d*) Be sanitary.

The hopper combining all these qualities satisfactorily has not yet been designed.

Large reservoir-type self-feeding hoppers are not successful.

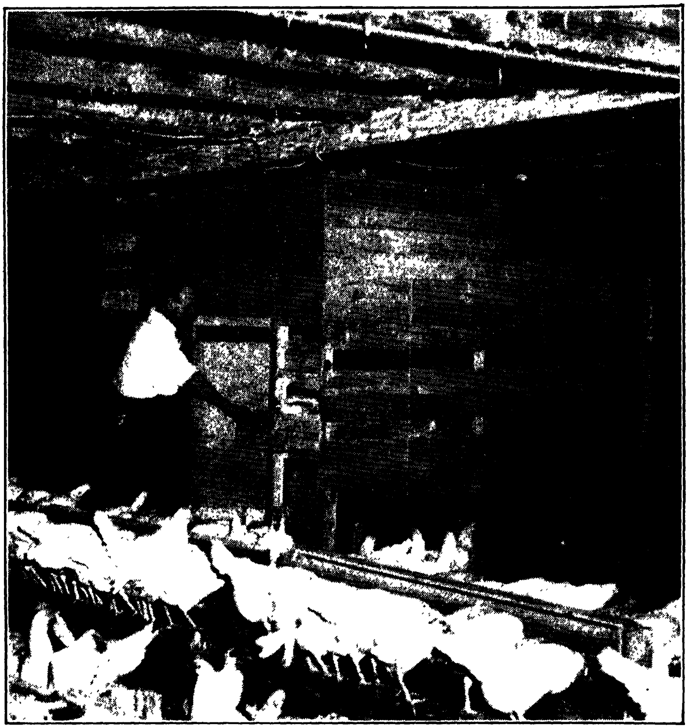


FIG. 47. The completed nesting room 8′ × 7′ with two units three nests high. Note the sliding entrance door which can be raised or lowered from inside. Note also the opening on two sides at the ceiling, providing air circulation.

Open-trough feeders are coming more and more into general use and are quite satisfactory, since the mash is easily obtained by the birds and is difficult to waste. Such feeders increase mash consumption, insure a constant supply of mash, and do not waste it when filled properly. They should be filled to within 2 or 3 inches of the top.

Fig. 48. A feed bin. Grain on the right and mash on the left. Note the bin is raised above the floor as a precaution against rats. The corner of an elevator is shown at the left.

Fig. 49. Feed racks for holding sacked feed. This construction permits cats to protect the feed from rats when the bags are stacked in rows. Sides are 2″ × 6″.

Small feeders, when accompanied by a large storage bin, come near reaching the ideal.

At least one foot of feeding space is required for each 5 hens.

Grit and shell hoppers are necessary. For small flocks, these may be small hoppers hung on nails against the wall or posts or an end partitioned off in the hopper or feeder. For large flocks the space between the studding can be used most effectively and economically by boarding from stud to stud to form the front and bottom of a hopper. Provide 2 to 4 feet of feeding space for shell and 1 foot for grit to each 100 layers.

G. Storage bins. One is needed for mash and one for grain, and each should hold feed enough to last 1 to 4 weeks. Storage may be in bins on each floor, in bags on racks, or in large storage bins on an upper floor, whence the feed is lowered in chutes.

For small flocks, heavy barrels and ash cans with covers serve the purpose satisfactorily. Keep bins where the birds cannot get on them and the weather cannot spoil the feed.

H. The water supply is most important, requiring more labor on many farms than any other item. Its absence quickly cuts production. When not properly controlled, it causes wet litter for a considerable distance around and away from the water receptacle and may increase the number of dirty eggs. It should be:

Adequate.
Clean.
Cooled by protection from the sun, large volume, or constant change.
Easily kept clean.
Arranged to catch and eliminate waste water.
Proof against freezing.

From 6 to 7 gallons of water are needed daily per 100 layers or about ½ pint per bird.

Running water is most satisfactory in supply and labor involved. Bubble fountains or small basins, 4 to 6 inches in diameter, will accommodate 100 layers. One pan 18 inches in diameter and 4 to 7 inches deep will care for 500 layers with either running water or float valve installation and is best arranged with an overflow device for protection.

FIG. 50. Automatic water supply for 400 to 500 layers. *a*, planks covering a pit which is connected by a drainpipe to the outside; *b*, concrete floor; *c*, drainpipe which carries waste water into the pit; *d*, short overflow pipe which screws into the bottom of the 18″ diameter drinking pan. To clean the water dish *d* is unscrewed. Note the float valve at end of water pipe.

When water has to be carried or used with stop and drain valve, pails or troughs are used. Two 12-quart pails serve 100 layers. The length of trough needed is determined by width, height, number of birds, and gallons of water required.

For example, if the trough is 12 inches wide and 7 inches deep, what length is needed for 100 layers?

7 gal. $\times$ 231 cu. in. water per gal. = 1617 cu. in. water needed

$12 \times 7 \times 1$ in. = 84 cu. in. per in. of trough

$1617 \div 84 = 19.25$ in. or 1.64 ft. of trough required

To prevent litter being thrown into the drinking water, *elevate the receptacles* at least 1 foot above the floor. Any desire for layers to step into the water or onto the sides appears greatly lessened when the standing surface is on a level with the top of the drinking dish and the dish is but partly filled. Water thrown by head shaking is also limited by this means.

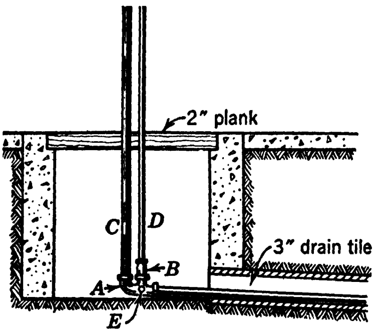


FIG. 51. A drain pit for the removal of waste water. Note the lip on the concrete to support the plank covering the pit.

Waste water results from overflow or cleaning, dripping beaks and wattles, and water thrown as birds shake their heads. A waste water pipe leading outside directly or into a dry well connected by tile to the outside takes the overflow and is practically essential in large flocks. A tub or other container, inside of which the water dish rests, catches much of the drip.

Size of pipe and installation. The dry or waste well may be 2 to 2½ feet deep to avoid freezing and for easy cleaning. It may be fitted with a plank cover. Galvanized pipe or copper tubing ½ to 1 inch in diameter is satisfactory in the house or for carrying water a few feet outside. Less friction results with the larger sizes. Outside pipe should be buried 4 to 4½ feet and under floors 1 to 2 feet to avoid freezing.

Freezing is reduced or prevented by insulated houses, stop and drain valves, running water, automatic water warmers, and electric soil cable.

Electric heating cable for poultry watering systems.[1] A lead-covered heating cable which was developed for heating soil for plants in hotbeds

[1] From Professor C. N. Turner, Department of Agricultural Engineering, Cornell University.

is being used by poultrymen to protect water supply pipes from freezing. The cable is flexible and waterproof so that it can be attached to all parts of the supply system. A thermostat turns on the electricity when the temperature of the pipe approaches the freezing temperature of water.

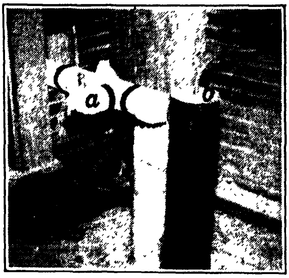


FIG. 52. Water pipe protected with heating cable and covered with air cell insulation. *a*, A protected faucet; *b*, handle which operates an underground shutoff. The rod extends to the shutoff through a length of tile. The shutoff is a precaution in cold weather against the possible accidental loss of electric current.

Since the cable carries only one electric heating wire, either the cable or a single conductor copper wire must be used for a return conductor to complete the circuit. Therefore, two strands of the cable are usually installed along the pipe, making a loop to complete the circuit. Whether a single or double strand of cable is used along the pipe depends upon the length of the pipe in relation to the length of cable and the amount of heat needed.

The cable can be installed to operate on 115 or 230 volts. Sixty feet of cable operating on 115 volts supplies 400 watts of heat, and 120 feet of cable operating on 230 volts supplies 800 watts of heat. Shorter lengths of cable for each voltage must not be used because it will operate at too high a temperature. Longer lengths can be used for each voltage, but the number of watts of heat will be correspondingly reduced. Several lengths of cable and the wattage produced on 115 or 230 volts are shown below.

WATTAGE OF DIFFERENT LENGTHS OF CABLE

Cable length (feet)	Circuit volts	Total watts	Watts per foot
60	115	400	6⅔
75	115	320	4⅓
90	115	260	3
120	115	200	1⅔
120	230	800	6⅔
150	230	640	4⅓
180	230	520	3
240	230	400	1⅔

A detailed study, made during the winter of 1944–1945, shows that approximately 5 watts of heat should be sufficient to keep the water from freezing in the pipes in a poultry laying house when at least 2½ inches of "air cell" insulation are installed around the cable and pipe. The electric energy consumption should not average more than 3 to 4 kilowatt hours per day during winter for a 60-foot length of pipe supplying 1000 birds.

FIG. 53. A water system protected by heating cable. *a,* Air cell insulation which surrounds the water pipe and cable; *b,* the thermostat which is connected with *c,* the electric convenience outlet; *d,* 4″ tile serving as drains for waterers on the floor above.

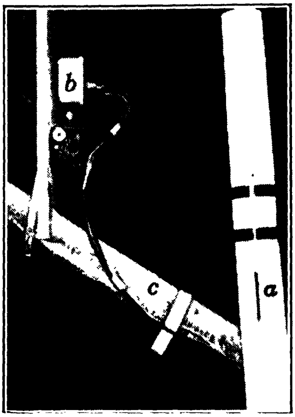


FIG. 54. The thermostat connected by a small wire to the expansion bulb lying against the pipe and exposed to the air by a slit, *a,* in the air cell insulation; *b,* the part of the thermostat to which the heating cable is connected; *c,* drain for water dish on the floor above.

I. Elevator. In multiple-story poultry buildings, feed, litter, crates of birds, and miscellaneous items must be carried upstairs and down. An elevator appears indispensable. Types of elevators vary from small dumb waiters to large electrically operated devices.

The type may depend on the size and kind of load and the height lifted. Locate the elevator where most labor can be

saved in servicing from it and where there is no interference with large-scale cleaning or other work.

A platform 3 by 4 feet will hold crates of birds or a bale of litter.

J. Track and car. In a long house, a track and car facilitate cleaning, feeding, watering, and gathering of eggs. They add to the expense, which is made up, however, in the saving of labor. A barn door track and rollers, and a frame of strap iron supporting a box or car which can be turned over and dumped, will be found serviceable. Instead of a car, long wire hooks may be suspended from the bar on which the rollers are fastened. Pails, baskets, etc., may be swung on these hooks, and feed or water carried in this way.

K. Caution against expensive appliances. There are on the market a great many utensils and fixtures. Some of these have considerable value, and some are impracticable or too expensive. Usually, fixtures may be constructed at the plant at much less cost. Care must be taken not to add to the investment more than is necessary for conducting a profitable business. The fixtures should not be elaborate and should be designed to save labor and to be sanitary and serviceable.

L. Hen batteries. The individual hen battery has been in use for several years. Each hen is kept in an individual cage or compartment about 12 by 18 by 17 inches high. The cages are built in batteries 18 to 24 cages long and 3 to 4 cages high. There is still a question whether the advantages can overcome the disadvantages and thus bring the batteries into more permanent use. They appear best adapted to restricted communities, such as those in or near cities where land is high in price and select retail trade is possible. Laying battery rooms may be constructed in barns, stables, or other outbuildings or in any unused rooms. The necessity for artificial heat and forced ventilation, together with better nutritional information, makes the venture more nearly possible in such rooms than the usual floor method might be. If battery rearing is practiced, less land is required than for rearing on range.

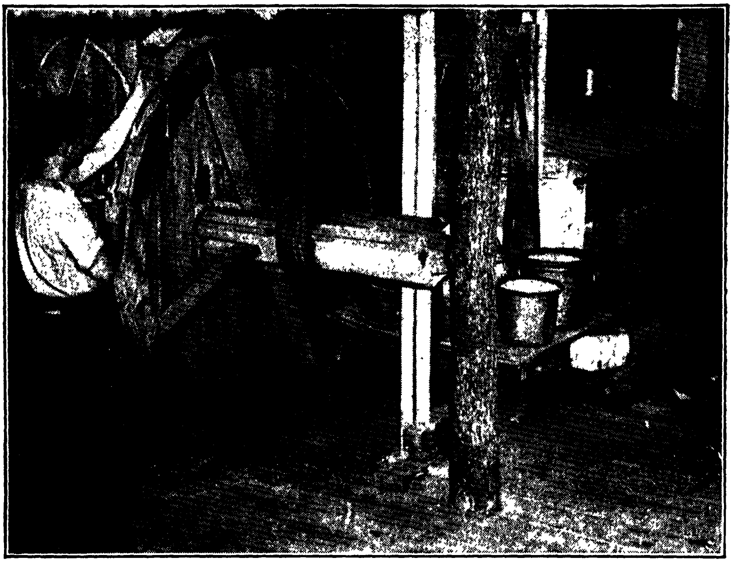


FIG. 55. A hand-operated elevator for moving feed, bales of litter, or crates of chickens one story. The 5′ diameter wheel is easily turned, thus raising by rope and pulley the load shown. Electric hoists are advisable for large plants.

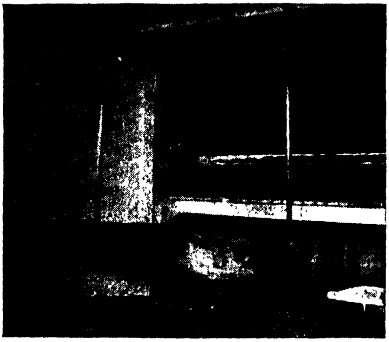


FIG. 56. A serviceable track and car. Note the barn door track and rollers and frame of pipe.

The need for nests, feed hoppers, droppings boards, and litter is eliminated. The vice of cannibalism among birds is not a problem. Egg records can easily be kept on individuals. Thus the laying batteries do have value in providing the opportunity to learn the quality of birds individually and to do early culling. It is probable, however, that the skill of the poultryman in observation and in physical examination of the birds will accomplish culling in a floor flock at less cost.

That the use of laying batteries has its unfavorable side is well known. Overhead costs, involved in more expensive buildings and in the batteries, place a greater financial burden on the business. The depreciation and upkeep costs on certain makes of batteries are high. Special ventilation in rooms accommodating several hundred birds is required to change the air several times an hour. The rooms must be warmed in cold weather to 40 to 45 degrees F. and be insulated to conserve heat in winter and keep the birds cool in summer. The usual method is to move the air with electrically operated fans located in walls or shafts and construct double, insulated walls and air intakes. In such construction the air may become too dry for poultry. A relative humidity of 50 to 55 per cent should be maintained.

The following remarks and summary were made after a careful study.[1]

High mortality and removal of many birds because of poor laying have an important bearing on the successful use of laying batteries. Every empty cage represents a loss of eggs and increased overhead expense unless a new bird can be found immediately to occupy it. Instead of eggs per hen, it is a matter of eggs per cage. At the Ohio Experiment Station, where records were kept, it was found that the eggs produced per cage yearly, when replacements were made promptly, were 206. The production per cage without replacements was 141. The

[1] Cornell Poultry Farm Service letter by L. M. Hurd. The authors have changed the original wording slightly.

total replacements for the year amounted to 63 per cent, of which 42 per cent were culls and 21 per cent were dead birds. It is obvious from the above figures that the successful operation of laying batteries necessitates a continuous supply of pullets for prompt replacements. This problem is one which every poultry keeper contemplating the installation of batteries on a large scale should consider seriously.

Good Management Necessary

It was first supposed that batteries would make unnecessary much of the care and skill in feeding and management required for layers in floor pens. Experience has shown that layers in batteries require even greater skill in feeding than floor layers. Good management requires that the birds be given frequent attention and individual observation. This may seem a simple, easy procedure, but in actual practice few will be able to meet the requirements of time, persistence, and patience needed. An indifferent and careless person will have less success with cages than with floor management of layers.

The reduction in mortality has been featured by some battery enthusiasts, but this has not been borne out in every instance by the evidence available. In most cases it is a vain hope to expect a significant reduction in mortality by the installation of this equipment. The mortality problem is more than a matter of change of environment and sanitation. It must be attacked from the standpoint of breeding, brooding, rearing, feeding, and management.

We may sum up the present status of laying batteries as follows:

(1) Equai or better egg production with equal or less mortality.

(2) Feed consumption about the same, or somewhat less, than for layers in floor pens. Rations and formulas are essentially the same.

(3) Both Leghorns and heavier breeds respond favorably in laying batteries.

(4) Nutrition requirements much the same as for those in floor pens, except for vitamin D and fiber, which are generally greater.

(5) Labor requirements for feeding and watering layers in batteries considerably greater than for floor pens equipped with labor-saving equipment.

(6) About one-third less floor space required for layers in batteries.

(7) Greater skill and care in feeding required for layers in batteries.

(8) The battery operator to be successful must be more alert as a caretaker and as a business man than his competitor who manages hens under floor conditions.

COMMUNITY SURVEY

1. Ask a carpenter to show you how to mark out rafters with a steel square. Record each detail.
2. What determines the time of year, among local poultrymen, when pullets are placed in winter quarters?
3. Ask several poultrymen what cleaning or overhauling they give the buildings before pullets are placed in winter quarters.
4. When a poultry house is being constructed in your locality visit it each day, if possible, and note the order in which the carpenter proceeds.
   (*a*) When are the sills put in place?
   (*b*) When are the corner posts and studs erected?
   (*c*) When and how is the floor laid?
   (*d*) When is the roof constructed?
   (*e*) When is the siding put on?
   (*f*) At what point in the construction are the windows, ventilators, and other openings finished?
5. Visit several poultry houses and obtain the following information in regard to each:
   (*a*) Perches:
      Amount of perch space per hen.
      Size of perches.

How are the perches supported?
Where are the perches located in the house?

(*b*) Droppings:
Where do night droppings fall? Why has the poultryman decided on this method?
Could labor in cleaning be saved by using another method? Why or why not?

(*c*) Nests:
What has governed the location of the nests?
Can the location be improved to save labor? If so, where and how might this be done?
What is the ratio of nests to hens? Is this sufficient?
What is the poultryman's reason for using or not using nest partitions?

(*d*) Broody coop:
Is a broody coop used? Where placed?
Is it sufficiently large to care for the broody birds?

(*e*) Feed hoppers:
What type is used? Where placed? What size are they and how many hens do they accommodate?
From where are the feeders serviced?
How is feed stored until used in the feeders?

(*f*) Water receptacles:
What type of watering equipment is used?
Are any of the buildings supplied with running water?
Sketch the system, if satisfactory, in one house, showing how water is supplied, waste cared for, and freezing prevented.

(*g*) Elevator. How is it serving a useful purpose?

(*h*) Track and car:
Estimate the amount of time saved by using this equipment. Is the expense justified?

6. Visit a laying battery plant if possible. How many more birds can the poultryman keep by the battery method? Are there any empty cages? Is the house more expensive than the usual laying house? How much more per bird? Is more or less labor required for a similar number of birds?

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Write your own state college for bulletins and plans on housing poultry recommended for your state.

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CHAPTER IV

PRINCIPLES OF HOUSING POULTRY

General information:

1. Why we house poultry.
2. The hen home.
3. The necessity for pure air.
4. Temperature.
5. Air movement.
6. Siding and walls.
7. Moisture.
8. Ventilation.
9. Direct sunshine.
10. Size of flock.
11. The comparative merits of types of roofs for laying houses.
12. Roofing material.
13. Foundation.
14. Floor.
15. Front.

1. Why we house poultry

We often hear it said that we cannot improve on nature. From nature's standpoint we probably cannot; but from the human business point of view and for the purpose we have in mind, we often can improve on nature.

For example, nature's object, with poultry, is to cause the hen to reproduce herself and maintain the race to which she belongs. In accomplishing this, the hen is required, under natural conditions, to live an exceptionally healthy and vigorous

life, as only by so doing can she produce offspring possessed of the qualities necessary for existence in the wild state.

The hen in her natural or wild state is required to lay but very few eggs, and these only in the spring of the year. She maintains her vigor by roosting where there is an abundance of pure air, and where conditions are such that only the birds endowed with the greatest amount of vitality survive. Although the bird that survives is very high in vigor, she loses decidedly in egg production by being exposed to severe climatic conditions and because there is no need to produce eggs and attempt to rear chicks during seasons of natural food shortage and severe weather.

The modern business hen is required to lay many eggs, and the effort to make her do so frequently results in a weakened and pampered hen, from nature's standpoint. The natural vigor of the hen is likely to be sacrificed somewhat, in the effort to secure heavier production, unless special precautions are taken to safeguard her health by methods of feeding and management. Other things being equal, the higher producing bird is by nature the more vigorous one, and is the better layer and the better breeder.

It is necessary to provide a comfortable poultry house in order to secure a satisfactory yearly distribution of egg production. The real problem in poultry housing is to determine how to balance the conditions that make for nature's method of maintaining health and vigor, and the conditions that produce man's commercially profitable hen.

2. The hen home

The best egg production is secured from birds that are comfortable and happy. The meaning of comfort to the hen carries with it all the factors which make the ideal environment. Environment includes all phases of management that have to do with the care of the hen.

To a large extent, the comfort of the hen is directly dependent upon the kind of house she occupies. A major part

of her time is spent there and it is there that she receives most care. The word "home" usually suggests "comfort." The hen home should be a place of comfort, safety, contentment, cheerfulness, and happiness. Given these, the hen responds. The man who provides them shows that he recognizes the fundamentals of egg production. Egg production is based on a contented mind, and not merely on a satisfied stomach.

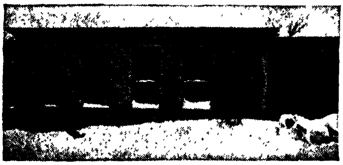


FIG. 57. A small shed-roof house, facing south; prevailing winds from N. W. Note the circulation which takes place within the house. The air is drawn out at the S. W. corner and in at the S. E. corner. This building was used several winters with the upper windows entirely out. The production was excellent and colds among the birds unknown.

We should think, then, in terms of a "hen home," rather than a "hen house." There is too often a vast difference between the two. The home we construct is to be rented to the birds. Our rent must be paid in eggs if it is paid at all, and it will bring revenue according to the way it provides comfort for the birds. The hen's attitude toward her surroundings will go far in egg production. The hen does not "will" to lay, nor a seed to germinate, but, if given the proper environment, both will respond.

3. The necessity for pure air

Perhaps the most important factor in securing comfort for the birds is an ample supply of pure air. When the amount of pure air is limited, a loss in vigor results. Protection from wind and storm is necessary, but a constant supply of pure air is absolutely essential for egg production. The hen breathes very rapidly, thus using much more air in proportion to her size than other domestic animals. King gives the following figures on the amount of air per 1000 pounds live weight each 24 hours.

Cow	2804 cubic feet
Horse	3401 cubic feet
Hen	8278 cubic feet

As a disease preventive, a health promoter, and a factor in good production, pure air stands high in importance. Nothing used by poultrymen in the attempt to secure good production is cheaper.

4. Temperature

Birds should be kept comfortable in the sense that they are protected from extreme cold and wind in winter and extreme heat in summer. Either extreme tends to retard production. While birds undoubtedly would be benefited if the temperature were not allowed to go below zero, or even below freezing, provided the supply of pure air were not diminished, there are no figures available, in connection with any present methods of applying heat, that show a profitable increased production as a direct result.

The most practical method yet devised to keep the temperature from falling much below freezing and the supply of fresh air in no sense reduced is to construct insulated walls. Proper house insulation and ventilation also largely reduce the difficulty from summer heat.

Involving somewhat greater observation and skill by the operator but less costly is the practice of using a small stove, such as a brooder or chunk wood stove, while a severe cold period is under way.

Experience is needed to determine when to start and stop the stove, how to operate it while maintaining the normal intake of fresh air, and not to raise the temperature much above 35 to 40 degrees F. Its proper use for a few days at such times may assist the birds to adjust themselves more easily to severe temperature changes.

It has been found that temperatures down to 10 degrees F. (above zero) in the Cornell 20 by 20 poultry house do not

affect production, and that temperatures lower than 10 degrees F. (above zero) cause comb frosting and may temporarily affect the production of the flock. However, no serious ill effects from low temperatures were experienced in the experimental poultry houses at Cornell over a period of 7 years when provision was made for the free egress of the warm moist air given off by the birds.

5. Air movement

Air flow, or movement of air through the pen, is a most important factor. It is caused by the heat given off by the birds, and is affected by the wind.

Vertical air movement. The warmth inside the house causes the air to expand and become lighter. This lighter air is urged upward by the incoming air, which is colder and which pushes underneath. Thus an air movement is set up.

During the day when the birds are on the floor, the heat from their bodies is fairly well distributed over the area. The air that comes in through the intakes passes down to the floor and up to the ceiling as it becomes warmed. When the birds are on the perches, the air that enters falls to the floor and moves across the floor to the perches, where the air near the birds' bodies is lighter. It then passes to the ceiling.

Further movements of the air depend on the type of wall construction and the method of ventilation employed.

Along with the vertical air movement just described, there is another important movement in open or curtained front pens. This is a *horizontal movement* due to the wind entering the house, going in at one end and out the other, depending upon the direction of the wind. The air makes a long sweep, or swing, to the back of the house, and from one end of the pen to the other. If the pens are not too long, the swing will be of moderate intensity; but, if long houses are not partitioned, or curtains or windows closed, the velocity of this air movement will become so high as to be objectionable.

In small pens or in large rooms holding several hundred birds

this movement may be reduced by closing curtains or windows at the front end where air is blowing in. (See Fig. 57.)

6. Siding and walls

A tightly constructed wall is desirable in the northern section of this country to protect the birds from strong prevailing

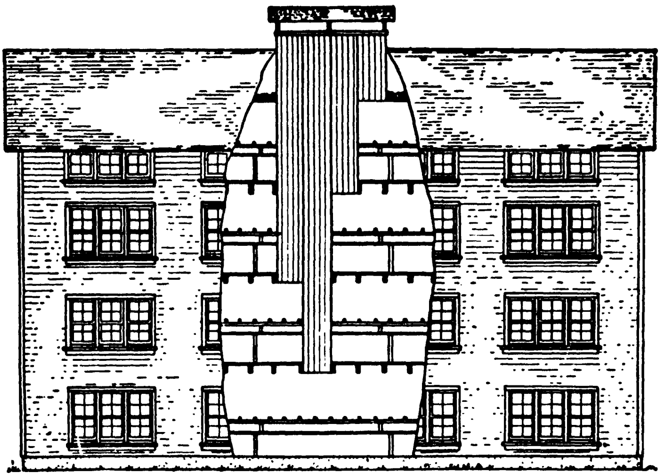


FIG. 58. The ceiling outtake-flue system of ventilation for a cold or uninsulated walled house. Each floor has a separate flue. From Cornell Ext. Bul. 315.

winds. Whether the wall should be of the simple or low-insulation type or well insulated will depend on the interior house condition desired and the cost involved. Also the type of air movement or ventilation is dependent upon the wall construction.

Walls of low insulation are in most common use today. They cost less but the interior is colder and more susceptible to outside temperature changes. Air should move through such houses steadily and without coming to rest against walls or ceiling long enough to permit cooling of air and condensing of moisture. The air outlet should open at the ceiling, if flat,

or at the highest point in the house, if of the shed type (Figs. 27 and 58).

A layer of matched boards of good-quality North Carolina pine, fir, hemlock, or spruce, well laid, covered on the outside with building paper, and finally clapboards or other siding

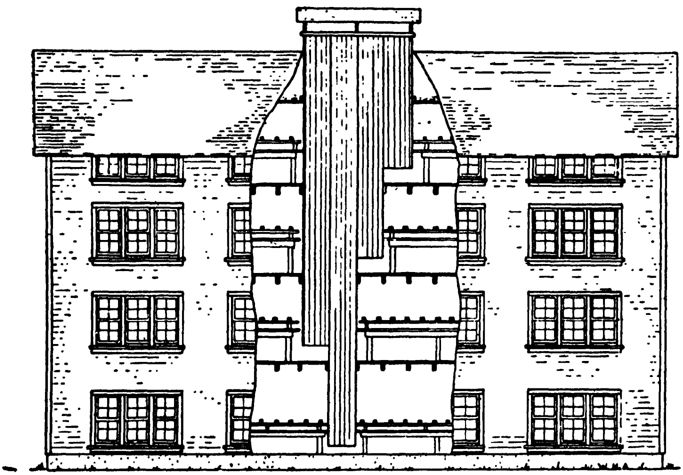
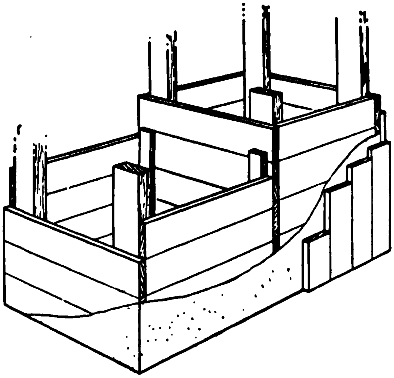


FIG. 59. The floor outtake-flue system of ventilation for warm or well insulated poultry houses. A 4″ wall filled with wood shavings gives good insulation. In both ceiling and floor outtake flues, one square foot of opening is required for each 300 sq. ft. of floor space. From Cornell Ext. Bul. 315.

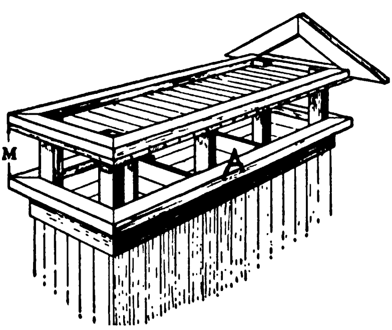
makes a satisfactory and protected wall. Paper should not be placed on the inside, exposed to the birds, as it may be torn.

Insulated walls are increasing in popularity where a more uniform and warmer interior is desired. They are more expensive. In such houses the air movement may be less rapid and the change of air slower. The air outlet may be through restricted front ceiling or rafter openings or through flues opening within 18 inches of the floor (Fig. 59).

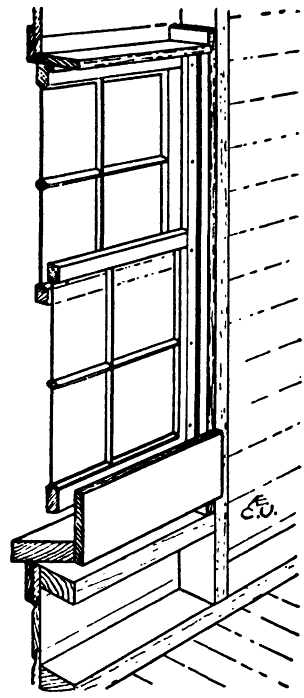
Fowls will destroy certain types of insulation board. When used on the inside, such boards may be protected by painting



The outside of the flues, whether one flue or several, is of two layers of boards with paper between. The common side between flues is of one layer of boards. Note construction of the second (left) flue against the first.



The ventilator head consists of the ceiling and the roof. The ceiling may be insulated with several inches of shavings before the gable roof is completed. The bottom of the opening *A* should be at least 2 feet above the ridge of the roof. From Cornell Ext. Bul. 315.



Window intake for use with the flue outtake. In a well insulated house an equal number of square inches are needed in both intake and outtake.

Fig. 60. Constructing the flue and window intake.

with a mixture of cement and water for 2½ feet above the floor or by covering the same area with metal or fine mesh wire.

For warm climates. In many southern states where the temperature seldom goes to zero, a single thickness of cove or novelty siding is all that is required.

Siding should be thoroughly dry when it is put on; otherwise cracks are likely to open up between the boards when wind and sun have dried them out.

7. Moisture

The amount of moisture in the pen depends on the ventilation, the watering arrangement, and the management of the pen. Excessive moisture may be a warning that the ventilation is inadequate. A large amount of moisture is expelled from a hen's body through voidings and breath, because of her large consumption of water and her rapid breathing. From these 2 sources, assuming the water receptacles are properly protected, the air in the house becomes quickly saturated, if improperly ventilated.

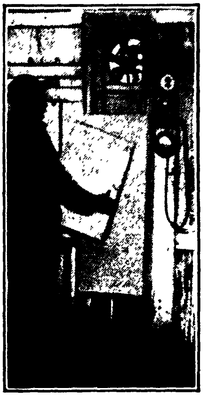
The condition of the litter (see page 269) and the temperature of the air in the house determine the rate of evaporation of moisture. The ventilation system is called upon to remove it.

8. Ventilation

In addition to the rafter and flue methods of ventilation, pages 41 and 83, the electric fan is being successfully used. Only one fan is needed per floor or room in the poultry house. The fan must move 1 cubic foot of air per minute per bird. "The amount of air that a fan can move depends upon the diameter of the fan, the shape and the angle of blades, and the speed of the motor. For that reason, the diameter of the fan alone, is not much indication of the amount of air it can move. Each company manufacturing fans rates its own product for

air movement and for the amount of power needed for the amount of air moved."[1]

The fan is mounted in an opening the diameter of the fan blades, and an air duct of insulating board is constructed



A. B.

FIG. 61. *A*. Outtake fan installed in sidewall near ceiling with short duct extending to within 20" of the floor. *B*. Cover is removed from opening behind the fan for oiling, cleaning, or taking air from the pen at ceiling level in warm weather.

RELATION OF FAN AND INTAKE OPENINGS TO FLOOR AREA

Floor Area (sq. ft.)	Size of Duct (inches)	Approximate Diameter of Fan (inches)	Number of Intakes (60 sq. in.)
400	12 × 12	9 or 10	2
800	12 × 12	9 or 10	3
1200	12 × 15	12	5
1800	15 × 15	12	7
2700	18 × 18	14	11

Courtesy Prof. C. N. Turner, Cornell Univ.

(Fig. 61). The opening at the base of the air duct should be just double the area of the fan opening. A service door is located near the top.

Inlets are needed, page 85, 60 square inches for each 250

[1] From article by Professor Paul R. Hoff, Department of Agricultural Engineering, Cornell University.

square feet of floor space, placed about the pen. None should be less than 8 feet from the air duct.

"The fan should be attached to a capacitor (or a split phase) motor, totally enclosed and with sleeve and thrust bearings. The motor should have a large capacity lubrication system so that it can be lubricated once each season and it will run through without further attention.

"Some type of overload protector should be in the circuit so that the motor will not burn out due to stopping when the current is on. Excessive back pressure caused by a high wind blowing against the outside wall where the fan is located, or stopping of the motor when an object is drawn into the blades causes overloading of the motor and may cause the motor to burn out unless it is protected by a device that cuts off the current in such an emergency. The most easily installed protection is a delayed action fuse of the right size for the motor. This type of fuse can be put into any fused switch.

"An open end motor of the variety commonly used for small appliances, and without overload protection is a fire hazard and should not be used for fan operation in a poultry house." [1]

9. Direct sunshine

The discovery of the importance of ultraviolet rays in the sunlight gave added weight to the sunshine factor in house construction. Unfiltered direct sunshine is an essential in modern poultry house construction. Space in the front and ends should be so placed and used as to permit sunlight to shine upon the fowls to give them vigor and to quicken their vital life processes. These sunshine openings should be provided with adjustable windows of glass or good glass-substitute or cloth curtains for use during short periods of unfavorable wind or weather (Fig. 32).

Exposure. East or southeast, south, southwest, and west are the exposures in their usual order of preference. If winds

[1] From article by Professor Paul R. Hoff, Department of Agricultural Engineering, Cornell University.

and storms are common from the south, the house should face east or in one of the other directions where the least disturbance to the air movement within the house may be expected.

10. Size of flock

Small flocks usually increase the cost of labor, equipment, and buildings. They are adapted to side line poultry keeping

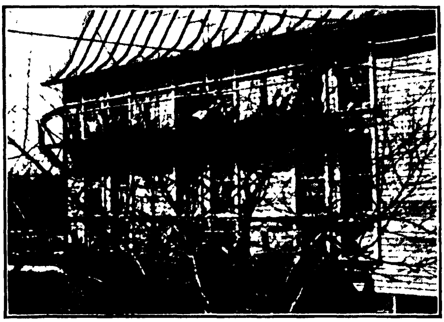


FIG. 62. Sunshine porches have been placed on both floors of this building.

or to poultry breeding farms. Larger flocks are more common on commercial plants. Units of 500 to 1000 hens per flock are desirable, although larger units may be successfully handled.

Commercial laying flocks are kept in confinement through the laying year.

A. Floor space. The smaller the flock, the more floor space is required per hen. Ten hens might need 6 to 8 square feet per bird. Leghorn hens may be kept profitably in flocks of 100 or more with an allowance of 3 square feet per hen. For heavier varieties, 4 square feet per bird is the usual figure. It is always well not to overcrowd.

B. Air space. Experiments at the Wye (England) Agricultural College indicate that about 40 cubic feet of air is necessary per hen per hour. These experiments showed that a

pen could be constructed in which the air would change four times per hour, and led to the conclusion that 10 cubic feet of air space per pound live weight is sufficient.

It is difficult to construct a large house and have much less than 15 to 20 cubic feet of air space per hen in the pen, unless

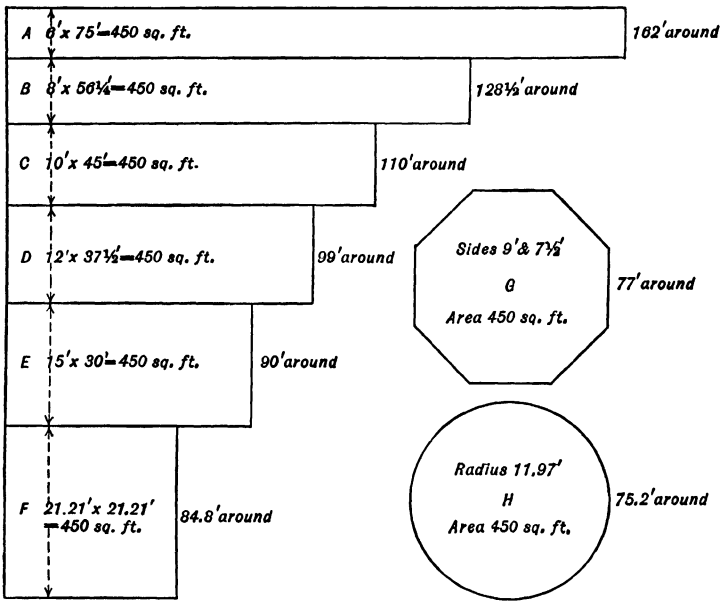


FIG. 63. Comparison of distance around a given area.

the floor space per bird is greatly reduced, or the ceiling is so low that the attendant cannot work to advantage. Either fault would show disappointing results. We may conclude, therefore, that the air space will be sufficient if the pen is made as low as is commensurate with the height of the person who is to do the interior work.

C. Shape. A study of Fig. 63 will show that the distance around a given area is less in a round poultry house than in one of any other shape. The expense of construction makes

the round or octagonal house impracticable. Of the other types, the more nearly square the house is, the less material is required to construct it and the cheaper will be the cost per hen.

D. Width. The deep house has certain advantages over the narrow one. It is likely to be cheaper in construction and more easily equipped to save labor. Modern multiple-story houses, ventilation, insulation, and feeding make the house that is wider than 15 or 20 feet practical, where formerly it was seldom used. Single-story houses are limited to 25 or 30 feet.

Width is governed by the purpose for which the house is to be used, whether new construction is necessary or existing buildings are to be made over, by the cost, the possible future use, the location, and the height.

A breeding farm doing individual pedigree or progeny testing work may find the longer, relatively narrow house more easily made into pens. Pens can be constructed in larger houses, however. Laying units of 100 to 125 are economically housed in a 20 by 20 pen. Five hundred layers do well in a 20-foot house of the proper length or in a 30-foot house 50 to 65 feet long, depending on the variety. Larger flocks are commonly found in houses 30, 40, or 50 feet wide.

Lumber may cut with less waste for one width of house than for another.

11. The comparative merits of types of roofs for laying houses

A. Monitor. The full monitor dates back to the time when a tight, single-story house, with sunlight reaching all parts, was thought to be ideal. It is not a practical laying house roof. Such a building may be remodeled by the use of a straw loft or by ceiling across at the plates or above, using the rafter, flue, or fan outtake.

B. Semi-monitor. One of the original open-front houses, it was first used about 1900. It helped focus attention on the value of fresh air for poultry while retaining supposed desirable features of the monitor. It is not a practical laying house roof.

C. A-shaped. This is usually built with sides from 1½ to 2 feet high. It covers a given floor space at reasonable expense. Headroom is lacking, and light is unevenly distributed over the floor. One house seldom accommodates over 150 birds.

D. Gable, or even span. A house with this roof has too much air space for comfort. Often it can be improved by ceiling and installing ventilation or a straw loft. Either results

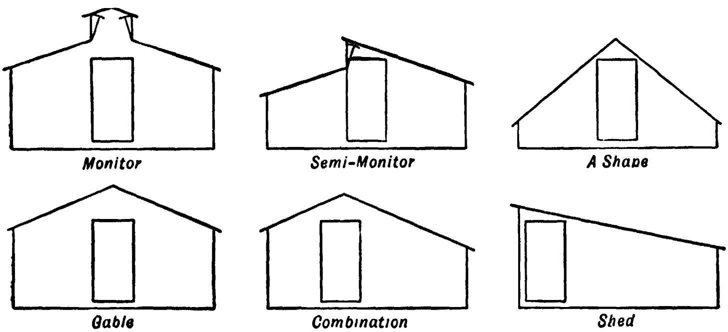


FIG. 64. Types of roofs.

in a cooler house in summer and a better-protected pen in winter.

To construct a *straw loft* lay poles from plate to plate or across the building about 6½ or 7 feet above the floor, and place boards on the poles, 1 or 2 inches apart. Two feet of straw should be placed on the boards, pressed firmly around the sides, and the rest allowed to be rather loose. A window or opening is cut in each gable, and air circulates above the straw. The warm, moist air from the room below works slowly through the straw, which absorbs the moisture, while the circulation above dries the straw and removes the foul air. This method of ventilation provides an abundance of constantly changing air.

Old sheds and buildings may be remodeled into comfortable laying houses by constructing a straw loft.

Gable roof construction is expensive, and front eaves troughs

are required to avoid muddy conditions on certain types of soil. The straw is dusty and a possible breeding place for vermin.

E. Combination. Next to the shed roof, the combination is perhaps most widely used, with one-third of the roof toward the front and two-thirds toward the rear. On a deep house it cuts down the air space by eliminating the high peak in front, but it is likely to cause trouble by the banking of air at the peak and the condensation of moisture there. Putting ventilators at the peak or boarding across the peak, from the front plate to a point on the rear rafters 5 feet above the floor and using the rafter outlet may eliminate the trouble.

F. Shed. This type is most widely used.

A very low pitch is possible, a rise of one foot in a run of 5 or 7 feet being sufficient. The shed roof is simple to construct, and the cost of construction is low.

G. Flat. The flat roof is new in poultry house construction. It is likely to gain popularity, as it reduces the air space and siding required. It is well adapted to the rafter, flue, or fan method of ventilation.

12. Roofing material

Prepared roofing is usually lower in price, moisture proof, and easily and quickly laid and repaired. It should be laid on a day when the sun will soften the tar in the paper and thus cause it to lie flat and bend without cracking.

Shingles require a steeper roof than paper and should not be used for a shed roof.

Metal roofing may be used above roof insulation or when an air space is between the roof and the room below.

The flat roof calls for a new type of roofing. The "built-up" roof is described in Bulletin 94, Ohio State University, and Bulletin 284, University of Connecticut. It consists of alternate layers of roofing paper and hot asphalt on wood sheathing, the first layer of paper being nailed down, with large tin caps,

and each layer thereafter being spread on hot asphalt. Just enough asphalt is applied with a long-handled brush to be covered by the width of the paper, and it should be spread only as fast as it can be covered by the roofing.

13. Foundation [1]

The foundation walls should be:

(1) Deep enough to prevent heaving by frost.
(2) High enough to keep surface water out.
(3) Heavy enough to support the building.
(4) Economical.
(5) Rat-proof.

A. Concrete. Concrete has no particular disadvantage. A "1–2½–5" mixture is desirable. This means 1 part of cement, 2½ parts of sand, and 5 parts of grout or coarse gravel. In figuring the amount of these ingredients, the following example will prove helpful.

EXAMPLE

Given a wall 10 by 3 by 1 foot.

Total space to be filled, 30 cubic feet, = the amount of coarse gravel or grout required.

Mixture used 1–2½–5

$\frac{2.5}{5}$ or ½ of 30 cubic feet = 15 cubic feet sand required.

⅕ of 30 cubic feet = 6 cubic feet cement required.

A bag of cement holds about 1 cubic foot.

B. Stone. Stone may be used as a base for the concrete wall (Fig. 26).

C. Posts. Wood posts are not desirable for permanent foundation.

Cinder Blocks 8 by 8 by 16 inches may be used as posts above ground.

Concrete posts are satisfactory below or above ground.

[1] See Chapter III for details of constructing a concrete foundation.

14. Floor

A desirable floor should be:

Moisture proof.	Smooth for cleaning.
Rat proof.	Sanitary.
Durable.	Comfortable for the birds.
Economical.	

A. Earth. It is impossible to secure all these essentials with an earth floor. There are times when the type of soil, the location of the house, and the first low cost make the earth floor desirable for a year or two.

B. Board. Floors above the first are most often of wood. The first floor when of wood should be protected from ground to sill by planks or earth or both to prevent the wind from blowing beneath. An opening should be left on one side for air to circulate and to prevent rotting. Two layers of boards, with paper between, make a protected but more expensive floor.

C. Concrete. The concrete floor, when properly constructed, meets all the requirements of an ideal floor. It is preferred for the first floor and is being widely used for upper stories where construction, framing, and reinforcement are ample.

15. Front

The front of the house may be open, or partly enclosed by glass or a good glass-substitute or cloth curtain, or a combination of these.

A. Glass front. Glass helps to light the floor on dark days and to offer some protection from storm. Through glass the interior of the house warms quickly during the day and cools readily at night. This may result in too great extremes of temperature in 24 hours in a house with an uninsulated wall. With good ventilation and better wall insulation, some of the objections to glass appear less important.

Glass is expensive to build and maintain and, unless it is cleaned frequently, the dust shuts out the light.

Another disadvantage is that ordinary window glass prevents the passage of the ultraviolet rays in the sunshine. To secure the benefits of these rays when the birds are confined, arrange the windows to open easily on sunny winter days if no curtains are used.

Some glass usually is provided. A good proportion in curtain-front houses seems to be 1 square foot of glass to each 16 or 20 square feet of floor space for conditions in the northern part of the United States. For insulated wall houses with no open space or cloth, 1 square foot of glass to each 11 to 15 square feet of floor space may be used.

B. Open front. This type of front admits a maximum of air and sunlight but allows storms to blow in. For this reason many poultrymen use cloth curtains.

C. Cloth curtains. Where correctly used, curtains give the advantages of the open front without its disadvantages. In the event of storms or winds from the front, they may be raised to cover the openings, and the birds are protected, while the curtains allow air movement through the cloth. About 1 square foot of cheesecloth or light muslin to 13 square feet of floor space suits northern United States conditions. More cloth or more open front may be used, depending on the climate.

Curtain frames may be made of 1 by 2 inch material. The frames may be arranged to slide down on the outside between cleats.

D. Glass substitutes. Many products of wide difference in durability and efficiency in permitting the passage of light, heat, and ultraviolet rays are for sale. The best of these can be used to advantage in the place of glass, all or in part. Air does not pass through most glass substitutes. They must be used with caution as part of a ventilation system.

COMMUNITY SURVEY

1. Which type of poultry house is most popular in the community, the open- or curtain-front, or a closed type?

2. How many houses do you know that are ventilated by the rafter method? Wooden flue? Metal flue? Fan?
3. Sketch the air movement in each method of ventilation.
4. What types of wall construction are used?
5. What percentage of the poultry houses are troubled with dampness?
6. What is the apparent reason for dampness in these buildings?
7. How would you remodel one or more of these houses to make them better?
8. How much floor space do local poultrymen allow for layers? For breeders?
9. What depth of house is most popular, and why?
10. Are partitions used in a long house?
11. Is there a long house in the community which does not have partitions?
12. How do the birds act in such a house on a windy day?
13. What type of poultry house roof is most common in the county?
14. What reasons are given for its popularity?
15. Do the poultrymen prefer concrete or board floors, and why?
16. What concrete mixture is used for the foundation? Floor?

CHAPTER V

FEEDING THE LAYING AND BREEDING STOCK[1]

A high degree of skill is required to secure the best results in feeding the domestic fowl. Feeding poultry differs from feeding other stock in that we must feed to suit the needs of the majority, or the average, of the flock and not the needs of a particular individual. Hens are like machines. The feeder supplies the raw material and the hen takes it and manufactures a portion of it into eggs. The hens that receive the best selection of raw materials can manufacture most efficiently and turn out the largest quantity of high-quality product.

Hens show by their actions, their appearance, and the eggs they produce, whether or not the feed is suitable. The successful feeder must study his birds, be quick to note trouble, and cater to their appetites. No set rule can be given as to the exact amount that is best. At all times, one should endeavor to feed all that the birds will eat.

With the large expansion in the size of poultry flocks and the necessity of reducing the amount of labor involved in egg production, easier short-cut methods of feeding have been evolved. These methods are becoming more popular on account of reducing to a minimum the hazard of the human factor. They rely more than they formerly did upon the instinct of the hen in choosing the feeds best suited to her daily needs and on the knowledge of the feeder in selecting the most perfect formulas for producing efficient results consistent with cost.

[1] For summer feeding, see Chapter XXIV.

Operations:

1. Essentials in feeding.
2. Laying rations.
3. Feeding mash.
4. Feeding grain.
5. Methods of feeding.
6. Feeding animal protein.
7. Feeding green feed.
8. Feeding grit, shell, salt, manganese, and phosphorus.
9. Supplying vitamin D.
10. Supplying the water.
11. Cooking feed.
12. Feeding the different breeds.
13. Feeding breeders.
14. Feeding birds under illumination.

General information:

Grain used for poultry.
Mash feeds used for poultry.
Animal feeds used for poultry.
Green feeds used for poultry.
Roots and tubers.
Miscellaneous feeds.

1. Essentials in feeding

The successful feeder, as a rule, attempts to observe the following essentials in flock feeding:

1. Feed to encourage the birds to eat large quantities of food.
2. Provide ample water, grit, and shell.
3. Feed grain and mash according to the method selected.
4. Send the birds to roost with full crops.

2. Laying rations

The success of modern-day poultry feeding no longer depends on home-mixed rations. Research in poultry nutrition has made great strides over the years. This information is made available in bulletins, letters, lectures, and special nutrition schools. Commercial feed concerns maintain extensive laboratories where individual feeds are tested for their nutrient content, and, because of the size of business conducted, these firms may be discriminating in their purchases, thus insuring the finest ingredients.

The producer can make no better choice of individual feeds nor build better mashes. The customary procedure today is to purchase the various mashes desired from reliable commercial feed concerns. Grain rations may be purchased ready mixed, or the whole or cracked grains may be purchased separately and mixed as they are emptied into the feed bins.

Many flocks of pullets prefer somewhat more wheat than corn, whereas molting hens and older birds often prefer more corn than wheat. They may be fed according to their preferences.

Whole corn may be fed instead of cracked corn. Barley and buckwheat may each be substituted for 5 to 10 per cent of corn and wheat.

If these suggestions are followed, the grain ration for pullet layers might be:

600 or 800 pounds whole yellow corn
1000 or 800 pounds wheat
200 pounds oats [1]
100 pounds barley
100 pounds buckwheat

A mixture of corn, wheat, and oats is most commonly used.

To those using open formula feeds the method of determin-

[1] From 5 to 20 per cent of oats or more, if the birds will eat them, may be included in the grain mixture.

ing the nutrient allowances according to the composition of feed ingredients, outlined in the following chapter, offers interesting possibilities.

3. Feeding mash [1]

In all methods of feeding laying hens a *dry mash* is always available for it supplies the bulk of the protein, minerals, and vitamins required by the birds. A standard laying mash usually contains from 18 to 20 per cent of protein. To prevent the accumulation of stale mash, the old mash should be brushed to the ends of the feeders before fresh mash is added, or fresh mash should not be added until the feeders are practically empty.

Dry mash may be supplemented with moist mash in all methods of feeding. *Moist mash* is fed when the birds are inactive or otherwise might not eat their normal amount of feed. Moist mash may be fed in either of two ways: (*a*) by pouring milk or water onto the dry mash in the hoppers at the rate of from 1½ to 2 quarts for 100 birds, or (*b*) by mixing water or, preferably, milk with dry mash to a crumbly state. It should be fed in the afternoon and before the night feeding of grain. Only as much should be given as will be eaten readily. An objection to the first method of feeding moist mash is that some of the liquid may get beneath the dry mash by running down the sides of the feeder. The mash not eaten may freeze or mold. Care should be taken to pour the liquid only where it will remain on the top of the mash, and to limit the amount to what will be eaten in a half hour. Mash in the form of *pellets* may be fed as a supplement in place of the moist mash.

4. Feeding grain

Each method of feeding, except the all-mash method, differs principally in the way scratch grain is fed. Grain is the chief source of the energy and heat-producing nutrients. Grains may be fed whole or cracked.

5. Methods of feeding

The choice of the method of feeding is determined by the experience of the feeder and his ability to observe the needs of the birds as they change from day to day, by the amount of time or help available,

[1] Feeding mash, Feeding grain and Methods of Feeding adapted from Cornell Bulletin 558, by H. E. Botsford, G. F. Heuser, and L. E. Weaver, "Methods of Feeding Laying Hens."

by the inherited egg-producing capacity of the birds, by the age of the birds, by the preference and prejudices of the operator, by the relative cost of mash and grains, and sometimes by the breed or variety.

A. The controlled grain method litter fed. In the controlled grain method of feeding laying hens a standard laying mash (from 18 to 20 per cent protein) is available at all times. Grain is fed sparingly or not at all in the morning, but in the late afternoon the birds are given all the grain they will eat. It is scattered by hand in the litter to induce the birds to scratch for it and to keep the litter loose and dry. This helps to maintain a "built-up" litter. The amount of grain is increased or restricted to control mash consumption. By withholding grain, the amount of mash eaten by the birds is increased. The aim usually is to have the layers eat approximately equal amounts of grain and mash. At times this relationship may change considerably. For example, in cold weather nearly twice as much grain as mash may be eaten. These variations are not of consequence so long as the *total daily intake* of feed continues high. During cold weather it may be advisable to give a small feeding of grain at noon to keep the birds active. Any of the morning grain in the litter at noon indicates that too much has been given in the early feeding. It is best to keep a record of the feed and to regulate it, giving about three-fourths of the grain at night and the rest in the morning and at noon.

The controlled grain method of feeding has been generally followed for many years. It is used at most laying tests, and by a majority of commercial poultrymen. There is some evidence that, with birds of mediocre or inferior inherited laying capacities, better results are obtained by this method of feeding than by the free-choice grain method. However, more skill and experience on the part of the operator are required.

B. Trough fed. The trough-fed grain method is a variation of the litter-fed method, but probably requires somewhat less skill and observation than are needed when the grain is litter fed. Usually the grain troughs are distinct from the mash troughs, but some poultrymen distribute the grain on top of the mash.

Grain fed in troughs should be available early enough in the afternoon for the birds to eat what they want before going to roost. About 4 o'clock is the usual time for opening the grain hoppers, but the time should be adjusted to regulate the proportion of grain to mash. The hoppers may be opened earlier when more grain needs to be eaten.

When all of the grain is fed in troughs, the litter may become packed down and badly soiled. To prevent this and still retain the advantage of trough feeding, some grain may be scattered in the litter in the morning. This applies also to the free-choice grain method. However, in both methods this increases time and labor.

Trough feeding of grain gives the timid and less active individuals a better chance at the grain; if disease is present, it is probably a safer method.

C. The free-choice grain method. A standard laying mash is kept before the birds at all times in open feeders. The grain, likewise, is kept constantly before the birds. Usually no effort is made to influence the amount of grain or mash eaten. If several grains are fed, they may be mixed, or each may be fed in separate feeders. A variation of this plan is to feed one grain, such as wheat or oats, by hand in the litter. The birds working in the litter help keep it loose and dry.

The free-choice grain method of feeding layers permits them to select the amounts of grain and mash, as well as the kind of grains, to satisfy their individual needs. Since laying hens must be fed as a flock, yet have varying individual requirements, the free-choice method may allow them to meet those needs more closely than does any other method.

Most of the minerals and vitamins required by laying hens are included in the mash. If considerably less mash than grain is eaten, as might be the case with free-choice feeding, especially in cold weather, possibly there may not be enough minerals and vitamins in the diet. However, in actual practice this difficulty is seldom experienced, probably because standard laying mashes usually carry excess amounts of these. When the grain intake greatly exceeds the mash consumption, it may be well to increase some of the ingredients in the mash or grain to guard against these deficiencies. For example, it is well to mix extra fish oil with the grain, or to otherwise increase the vitamin D in the ration. The same result could be accomplished by restricting the grain feeding temporarily.

The method is particularly well suited for the inexperienced poultryman and is used on many large commercial egg farms. An advantage to the caretaker is the convenience, because no definite time for feeding the grain is required and more grain can be carried to the birds at one time.

Best results are obtained with this method when the layers have an inherited capacity for high egg production. Some strains have failed to respond to this method. This is one reason why the restricted grain method is often preferred. However, with nearly all strains of birds that have been bred and selected for high egg production, the free-choice method of feeding laying pullets has generally resulted in egg production, egg size, body weight, and viability equal to those obtained by restricted grain feeding.

D. The free-choice grain method with mash concentrate. The mash concentrate method of feeding laying hens is the same as the free-choice grain method except that the mash has a higher protein content. Its aim is to insure a normal intake of protein, vitamins, and minerals by the laying birds, even though they eat much more grain than mash. Results of limited experiments by this method of feeding do not indicate that it has any advantage over other methods.

E. The all-mash method. The all-mash method of feeding uses no whole or cracked grains. The mash has a protein content of from 15 to 16 per cent. Mash is kept before the birds in open feeders at all times. Moist mash is fed when it seems advisable to insure adequate feed intake. All mash rations must be coarsely ground.

This method has all the time-saving advantages of the free-choice method and also gives a more constant intake of protein and vitamins. The method has never found favor with New York poultrymen, chiefly because of the difficulty of getting the laying birds to eat enough mash to sustain maximum production and to maintain body weight. In general, experimental results favor grain and mash feeding.

6. Feeding animal protein

Meat scrap, milk, or some other form of animal protein is a desirable part of the ration for the production of either eggs or meat. The hen is naturally a meat eater.

A minimum of 3 to 4 per cent of the total ration should be animal protein feed. It is usually fed as part of the mash mixture and should be ground fairly fine to prevent the birds from sorting the mash over and picking out the pieces of scrap. The balance of the required protein may be of vegetable origin. (See soybean oil meal, page 112.)

All animal protein feeds such as meat scrap, meat meal, tankage, fish meal, and dried milk products are exceedingly variable in feeding value. Insist upon securing guaranteed analyses. A combination of high-quality meat scrap, fish meal, and dried milk is preferable to any one of these alone.

7. Feeding green feed

At all times of the year green feed is desirable. It is rich in vitamins and should supply any that are lacking in the other ration ingredients. In this sense it is a protective feed.

A lack of it is often a cause of ill health and low production. It acts as a tonic, stimulating the appetite, and also aids the digestive tract in functioning properly, securing for the bird a larger utilization of the feed consumed. Too much succulent feed may decrease grain and mash consumption. Five to 10 per cent of alfalfa leaf meal in the mash or 5 pounds of cabbage or other green feed (page 114) to 100 hens may be given per day at noon or late afternoon. See page 130 for feeds containing carotene and xanthophyll.

8. Feeding grit, shell, salt, manganese, and phosphorus

Grit and *shell* should always be before the birds, in hoppers or boxes.

Grit should be hard and angular. It is used to crush feed in the gizzard and is not itself a feed. Grit does for the hen what teeth do for other animals. Nothing passes through the bird's body that is not thoroughly ground and pulverized by the gizzard.

In recent Cornell tests it was found that granite grit with oyster shells is preferred; the second choice is calcite grit which serves as both grit and a calcium source.[1] Compared with shells alone, 0.7 pound per hen of granite grit plus shells increased the average production per bird in 42 weeks of the test by 15 eggs and reduced the amount of feed per dozen eggs by 8 per cent.

Oyster shell contains calcium carbonate, thus supplying calcium, which is an egg-shell and bone-making material and a very important mineral in poultry feeding. Without a source of lime, soft-shelled eggs are likely to result, together with the habit of egg eating.

Crushed oyster shells gave stronger egg shells and maintained body weight better than other calcium sources used in the Cornell test.

Salt aids digestion by rendering the feed more palatable. It supplies sodium and chlorine, two essential minerals present

[1] *Poultry Science,* March 1946, Vol. 25, No. 2, page 173.

in insufficient amounts in common foodstuffs. The exact amount needed has not been determined. As with other animals, large amounts of salt will injure the birds if they are forced to eat it. It is customary, therefore, to add salt to the mash in amounts of 10 pounds per ton or 5 to 10 ounces per 100 pounds. A wall hopper of salt in the pen permits the birds to supplement their needs and is being used with no harmful effects.

Manganese deficiency results in low egg production, slightly decreased fertility, and low hatchability. The addition of ¼ pound of anhydrous manganese sulfate or manganese carbonate, thoroughly mixed in each ton of mash for layers or breeders, usually corrects a deficiency of this mineral.

Phosphorus is needed in small amounts to balance the calcium-phosphorus ratio in the blood and bones. This ratio is roughly 2 to 1. Part must be in the inorganic form since organic forms, being locked up in the form of *phytin phosphorus,* are not utilized well by poultry. Steamed bone meal, dicalcium phosphate, and defluorinated rock phosphate are common sources. Rock phosphate containing 0.3 per cent fluorine has had no harmful effects on poultry.

Large amounts of minerals, when birds are forced to eat them, are harmful. Judgment and precaution are as essential in the use of minerals as in determining the other ration ingredients.

9. Supplying vitamin D.

Feeding oils are one of the sources of supply of vitamin D for poultry feeding. For the importance of vitamin D, see page 132.

About November 1, in the latitude of New York State (elsewhere when the amount of sunshine is considerably lessened during the winter), vitamin D should be given to the layers and breeders. Continue through the entire year if birds are confined.

Feeding oil may be fed either in the grain or in the mash. The grain should always be trough- or hopper-fed when mixed with the oil, since it will collect dirt if scattered in litter and some of the oil may be rubbed off on the litter and lost. The mash, of course, will be fed in hoppers.

Amount to use. Refer to the table on page 108. If equal parts of grain and mash are fed, each 100 pounds of mash should contain approximately 2½ pints or pounds of 85 A.O.A.C. unit oil, or ½ pint or pound of 400 unit oil, and so on.

If ⅓ grain and ⅔ mash are being consumed, 1.8 pints or pounds of 85 unit oil and less of the more potent oils is needed in each 100 pounds of feed.

The *free-choice* method of feeding with resulting two-thirds grain and one-third mash consumption requires 3.5 pints or pounds of the 85 unit oil added to the mash.

Modern methods of concentrating or "reinforcing" oils provide varying amounts of A.O.A.C. units of vitamin D per gram of oil.

The table on page 108 shows the number of units of D required in 1 pound of mash under these three methods of feeding, and, for different unit oils, the percentage and the pounds of oil needed in the mash.

Most poultrymen when feeding *free choice* will probably use a mash containing 2.0 to 2.5 per cent of oil. This is insufficient for the total ration. The proper amount will be provided, however, by adding 1 to 1¼ pints of 85 or ½ pint of the 400 A.O.A.C. unit oil to each 100 pounds of grain.

How to mix. Spread over the grain as it is being emptied into the storage bin, or spread over the entire pile and mix.

Do not mix more than a two weeks' supply at any one time as the vitamins of feeding oil are subject to oxidation in the presence of air.

Sterols. In recent years D-activated animal sterols have been used to fortify and standardize the feeding oils in vita-

min D potency. Sterols supply vitamin D only, whereas feeding oils contain both A and D. Sterols are a product of brains

AMOUNT OF FEEDING OIL REQUIRED BY HENS *
(pounds)

Guaranteed potency of fish oils and D-activated animal sterols in A.O.A.C.† chick units		Ration: One-half grain, one-half mash		Ration: One-third grain, two-thirds mash		Ration: Two-thirds grain, one-third mash	
		Units of vitamin D per pound of mash: 900		680		1360	
Per gram	Per pound ‡	Per 100 pounds	Per ton	Per 100 pounds	Per ton	Per 100 pounds	Per ton
85	38,590	2.4	47	1.8	35	3.5	70
150	68,100	1.3	26	1	20	2	40
250	113,500	0.8	16	0.6	12	1.2	24
400	181,600	0.5	10	0.37	7	0.76	15
800	363,200	0.25	5	0.2	4	0.38	7.5
1,000	450,000	0.2	4	0.15	3	0.3	6
2,000	900,000	0.1	2	0.07	1.5	0.15	3

* When the percentage of oil in the mash is less than shown in the table for any given guarantee of vitamin D units per gram of oil, additional oil may be mixed with the grain. The grain should then be hopper-fed.

† According to the vitamin D chick assay of the Association of Official Agricultural Chemists.

‡ 454 grams = 1 pound.

and spinal cords from beef animals or similar materials from marine animals, subjected to irradiation to synthesize and manufacture the D vitamin.

10. Supplying the water

The birds must have access to water during the entire day. Water softens the food in the crop and in other parts of the digestive tract, thereby making it ready for grinding and digesting. It serves as a carrier for transporting nutrients in the body, as blood. The hen's body is 55 per cent and eggs are 65 per cent water. A constant supply of water must be available, therefore, to keep up the composition in the body and to help make eggs. Water, coupled with rapid breathing, keeps the inside of the hen's body cool in summer and is the only means of cooling from the inside. As a result, birds use much more water on warm days and during heavy laying periods.

Water is as important as feed and must be supplied regularly and in sufficient quantities.

11. Cooking feed

It is not considered profitable commercially to cook feed. Cooking or exposing to high temperatures reduces the protein value of some feeds. However, the protein of ground soybeans is made more efficient by heating. When beans or potatoes are fed, cooking renders the starch more digestible.

12. Feeding the different breeds

When one is feeding for egg production, the practices outlined in this chapter may be applied to any breed. The heavier varieties may require somewhat more care on the attendant's part and probably more restricted grain feeding to keep them active.

13. Feeding breeders

Breeders are fed the same as layers. More riboflavin and manganese are required for high hatchability, and hence milk, dried whey, or other supplement for replacing milk is added.

Ten to 12 quarts of liquid skimmilk or buttermilk or 4 to 5

pounds of the condensed milk products a day for 100 hens will replace the dried milk in the mash.

Four ounces of manganese sulfate is required per ton of mash.

When the breeders stop laying and molt, the amount of grain should be increased. (It may be hopper-fed at this time.) Sixty to 70 per cent yellow corn and 30 to 40 per cent wheat is preferred by many flocks during this period. Green food and milk should be furnished in abundance.

Heavy grain feeding should be practiced during the winter. In the spring, the breeding flock can be handled in the same manner as the laying flock, both consuming a larger proportion of mash.

Artificial illumination should be given just before the hatching season. (See page 166.)

14. Feeding birds under illumination

The simplest rule to observe in feeding under illumination is to allow the birds to *fill their crops to the fullest capacity at night* before going to roost. Many flocks of birds go to roost with their crops only partly filled. The directions laid down in this chapter should take care of this requirement.

GENERAL INFORMATION

Composition of ingredients commonly used for poultry will be found on page 126.

Grain used for poultry feeding. *Yellow corn* is a desirable poultry feed, and one of which fowl are fond. It is best when fed with other grains. It contains a large amount of digestible nutrients, is usually cheap, can be easily raised, transported, and stored, supplies vitamin A, and fits well in a ration. As a part of the grain mixture, it is generally fed cracked, but it may be fed whole with equally good results any time after the birds are 10 or 12 weeks old. It is a xanthophyll-bearing feed and imparts yellow color to the yolk and yellow pigment

to the skin. Corn contains a large amount of carbohydrates and should be fed with other feeds which balance it.

Wheat is very palatable especially through the first laying year. It is adaptable to feeding fowls because of its size, color, and the large amount of nutrients which it contains. It should be fed with other grains. Soft or hard wheats or shrunken wheat which is sweet and clean are desirable for poultry feeding.

Barley is not so palatable as wheat but makes a fairly desirable ingredient for poultry rations. It may be fed as recommended for oats.

Oats is a valuable poultry feed. The hull may possess a factor which lessens the cannibalistic desire of poultry. Five to 20 per cent or whatever the birds will eat may be included in the grain ration. Some poultrymen provide free-choice hoppers of oats in the laying pens as a "pickout" preventive. Start feeding oats to chicks at 6 to 8 weeks of age and continue throughout life. They should not be fed as the only cereal.

Kafir corn has a composition much like wheat. The kernel is small. It is quite palatable. It is not quite equal to yellow corn in feeding value but may replace it in part.

Buckwheat is an important feed in localities where it is grown. It is used especially in the winter ration. It has a heavy shuck and should be fed in amounts not to exceed 30 per cent of the scratch grain. It produces a light-colored egg yolk. It may be used either whole or finely ground in the mash mixture.

Rye has an extremely hard kernel and apparently is unpalatable to poultry. Large quantities are likely to cause digestive troubles. It may be fed in quantities of 5 to 10 per cent of the grain ration.

Mash feeds used for poultry. *Cornmeal* is the clean, ground product of the entire corn kernel. It is an efficient and palatable feed. Generally it should form a part of the mash mixtures. Yellow cornmeal is more valuable than white owing to its vitamin A potency, a factor white corn does not possess.

Red dog flour is a low-grade flour and is valuable as a feed, especially in fattening rations.

Ground heavy oats are a highly desirable constituent of the mash. They are rather bulky. They may comprise 25 per cent of the mash mixture.

Soybean oil meal is a valuable source of vegetable protein. It can be used in the mash to replace three-fourths of the meat scrap or fish scrap, substituting 6 pounds for each 5 pounds of scrap removed. Raw soybean meal is inadequate. The protein must have been heated.

The phosphorus in soybean oil meal is not all readily available to poultry. In its organic form it is locked up in a form known as "phytin." Although its composition shows ample phosphorus, forms of inorganic phosphorus must be included in the ration. Such forms are bone meal, dicalcium phosphate and defluorinated phosphatic limestone.

Linseed oil meal is rather laxative in its effect. It is a high-protein feed, but is not palatable, probably owing to its sticky nature. It should not be fed in amounts exceeding 5 per cent of the mash.

Hominy may be used in the same way as cornmeal, the yellow variety being preferable to the white. It is not quite equal to yellow corn in feeding value.

Gluten meal is high in protein and vitamin A. It may replace one-half of the meat scrap in a laying ration. It gives yellow color to the flesh when corn ration is inadequate.

Wheat bran is a bulky food, low in nutriment, slightly laxative, and is a very beneficial feed.

Wheat standard middlings are very similar to wheat bran but are ground more finely, and are less bulky and slightly more nutritious.

Wheat flour middlings are somewhat more nutritious than the standard middlings. Although a more sticky feed, this stickiness is not a handicap in the usual mash mixture. It is valuable as a mash constituent.

Wheat feed is a mixture of wheat bran and middlings and is more or less variable in the proportion of these ingredients. Its composition is between the two, and it may be used in place of them.

Cottonseed meal is high in protein but used sparingly in poultry feeds.

Buckwheat middlings. See Buckwheat, page 111.

Animal feeds used for poultry. Protein from animal feeds supplements proteins of vegetable origin and gives a better distribution of the essential amino acids. (See page 120.)

Meat scrap is one of the most desirable animal feeds. It is the most convenient and usually the cheapest form of meat but may vary widely in feeding value, depending on the amount of by-product material included.

Fish products in general are not so palatable as meat scrap. The protein content in fish scrap is usually higher and of better quality than that in meat scrap. When properly prepared, fish scrap is believed to be richer in vitamins and manganese than most meat products fed to poultry. There is wide variation in value.

Tankage is less suitable for poultry than are meat scraps. The birds do not like it so well as some other animal feeds. It is less uniform in quality and does not produce as good results as does meat scrap.

Dried-blood products are not suitable for poultry feeding. They are high in protein but are very unpalatable.

Liquid or dried skimmilk, buttermilk or whey, and the condensed milk products are valuable sources of riboflavin and animal protein. They are easily digested, palatable, and aid in the digestibility of the entire ration.

The inclusion of 7.5 per cent of dried skimmilk or dried buttermilk or 5 per cent of dried whey in mashes for chicks is adequate in supplying their need for this vitamin. Ten per cent of dried skimmilk or 6.5 to 7 per cent of dried whey in the mash is sufficient for breeders while the need of layers, not used for breeding purposes, is satisfied when the laying

mash contains 5 per cent of dried skimmilk or 3.5 per cent of dried whey. Experience also indicates that if liquid skimmilk or buttermilk is constantly available, the birds will receive sufficient riboflavin.[1]

Distiller's solubles are high in riboflavin and may replace milk products for that nutrient.

Green feeds used for poultry. *Alfalfa meal* is a valuable feed. Like clovers and some pasture grasses it is a good source of vitamins. (See table, page 130.) For this reason and because of its availability it is well adapted as a mash ingredient. On many poultry farms, 5 to 7½ per cent of alfalfa meal in the mash supplies the necessary green food without excessive yolk coloring. It is not a succulent feed. Sun-cured alfalfa is much less valuable as a source of vitamin A than is dehydrated alfalfa, although there is a slight loss by oxidation during dehydration and in outdoor wilting. Dehydrated alfalfa meal and ordinary alfalfa meal are about three-fourths and one-half as rich, respectively, in riboflavin as is dried skimmilk.

Green pasture provides green food in the most natural form. Its use on range for breeding birds and for rearing is desirable because of its palatability, succulence, high digestible protein, mineral, and vitamin content. It is high in xanthophyll. A proper green range may slightly reduce the food cost for rearing.

Recent results at Cornell showed only moderate savings in feed cost. Good pasture, compared to ordinary pasture, permitted slightly restricted feeding and a feed saving of 3 to 8 per cent with no unfavorable influence on weight, sexual maturity, or mortality. The best use of pasture came from a modified ration, thus saving the cost of protein and vitamins and consisting of:

Whole wheat for the grain
Ground wheat for the mash

[1] From Cornell Extension Bulletin 348.

Add to 100 pounds of ground wheat:
- 4 pounds dicalcium phosphate
- 1 pound calcium carbonate (ground limestone)
- 1 pound iodized salt

Wheat contains sufficient manganese.

Investigations indicate that Ladino clover and Kentucky bluegrass are of special value in poultry pasture mixtures for the *Northeast.*

Best feeding value is obtained when the pasture is closely grazed or kept mowed to a height of 3 to 4 inches.

A poultry pasture mixture suggested by Cornell:

Ladino clover	2 pounds per acre
Kentucky bluegrass	12 pounds per acre

Ladino clover seed may be sown on carefully fitted land to which has been added 400 to 600 pounds of superphosphate and 100 to 200 pounds of muriate of potash per acre, and lime, if needed. Excellent results have been secured when Ladino clover seed is broadcast on sod land which is sweet and well fertilized as a used poultry range may be. Pasture seeded in early spring is ready for use the following season and may be used the same midseason, if necessary and if it is not overstocked.

Grasses for forage or for cutting and feeding green across the *southern* part of the country are Bermuda, rye, and carpet grasses, Lespedeza, soy beans, and White Dutch and Bur clovers.

The *North Central States* find Sudan grass, the vetches, alfalfa, clovers, and the green growth from planting small grains adapted to their conditions.

Grass silage may be prepared for winter use. One may question its value compared with alfalfa meal and other usual mash containing vitamins, when considering costs of preparation, containers, and labor involved.

Corn silage may be used in small amounts.

Roots and tubers. In this group, yellow carrots are the most desirable. They are satisfactory substitutes for field-grown greens.

Cabbage is an excellent succulent, especially for fall and early winter. Fowls prefer cabbage to most other vegetable feeds. The small, unmarketable heads may be used to advantage for poultry.

Any vegetable, such as lettuce, onions, spinach, kale, and the like, may be used as green food.

Miscellaneous feeds. *Molasses* may be used to replace some corn. Five per cent is satisfactory but 10 per cent may cause a temporary diarrhea. Molasses carries the anti-dermatosis vitamin but is too variable to be a dependable source. It has only slight growth properties and carries little or no riboflavin. It is a potassium carrier and used, therefore, in control of blue comb. See page 231.

COMMUNITY SURVEY

1. Ask several local poultrymen what rations they are feeding laying hens.
2. What method of feeding grain and mash is followed?
3. What proportion of grain and mash are they feeding?
4. How many trips are made to the laying flock each day in winter?
5. What work is done on each trip?
6. Do they feed the grain by pounds or quarts?
7. How much is given per 100 hens?
8. What determines the amount of grain fed? The amount of mash fed? The form of animal protein fed?
9. Is green feed given to layers, breeders, growing birds?
10. What kind is fed to each?
11. How much is fed? What determines the kind and amount given?
12. How many hoppers for grit and shell are in each pen?
13. Is the water supply sufficient and clean?

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CHAPTER VI

PRINCIPLES OF FEEDING LAYERS AND BREEDERS

The laying flock uses feed for three purposes: first, for body maintenance; second, for increasing body weight; and third, for increasing and maintaining egg production.

Maintenance of the body is the first consideration in good feeding. About three-fourths of the total feed consumed goes for this purpose when the fowl is in laying condition. One hundred birds averaging 4 pounds will consume about 19 pounds of feed daily when not laying and 24 to 27 pounds when producing 50 per cent and above. The ration should provide sufficient nutrients that are in a palatable form and easily obtained by the birds. For the first several months of laying, pullets should increase in body weight. This adds importance to a proper and ample food supply. If the ration is not in the proper form to supply the needs of maintenance, growth, and production, maintenance is more likely to have the preference under normal circumstances, because self-preservation is the first law of nature, and eventually the constant wearing and breaking down of body tissues must be repaired. Birds that inherit exceptionally high productive capacity, if not given the proper amount and kind of ration, are very likely to lay so heavily that they lose their body weight and lower their vitality. Often fall and winter molt results.

Under normal conditions, production follows after the body needs are supplied. It requires considerable feed to build up and maintain the body to the point of production. After this has been done, the actual production of eggs requires but a small part, comparatively, of the daily rations. No profit is

derived from merely maintaining the body. The profit comes from the production of meat or eggs. The skillful feeder handles the birds so as to enable them to make the best use of their ration. This results in the greatest production at least cost.

If, therefore, we can supply a ration which will furnish the material needed to build and maintain the body and produce the number of eggs which the fowl is capable of laying, and at the same time maintain good health, we shall have a balanced ration.

General information:

1. Definition of terms.
2. Nutrient allowances for chickens.
3. Suggested levels of nutrient allowances for chickens.
4. Ingredients that supply vitamin A.
5. How to calculate the composition of feed ingredients.
6. Further feed factors.
7. The importance of vitamins in feeding poultry.

1. Definition of terms

There are a number of terms which should be defined before the principles of feeding are discussed further.

A *balanced ration* is one that consists of the proper nutrients in the right amounts for the purposes intended. These consist of protein, carbohydrates, fat, fiber, minerals, vitamins, and water.

A *nutrient* is any constituent of a feed that goes to produce heat or energy or to build body tissue.

Feeds are composed of water and dry matter. The amount of water in feeds varies greatly, but is not sufficient to supply the bird's needs; therefore, water must be furnished.

Dry matter is made up of inorganic and organic substances. The inorganic matter is composed of minerals or ash. The organic substances consist of combustible material, such as sugar, starch, fat, protein, and fiber.

The inorganic constituent, *ash,* is present in small quantities in all feeds and in all parts of the body, and is the non-combustible material. It is used in the building of bone and in making egg shells. It is of more importance in the feeding of young stock than of mature stock, since large amounts are needed for building the framework of the growing body. Ash is usually present in feeds in sufficient quantity to supply the adult fowl's needs, with the exception of lime for making egg shells, which should be supplied in the form of oyster shell or limestone.

The principal function of *protein* is to make the lean meat, hair, nerves, and feathers in the fowl and the albumen or white of the egg. It is essential in the building up of tissue and in egg production. It consists of compounds which contain nitrogen, and it is an indispensable, and generally the most expensive, part of a ration. No nutrient will take the place of protein, but a part of the protein is sometimes used as fat-forming material or energy.

There is no specific disease due to a shortage in protein although stunting, or reduced production, may result.

An excess of protein may be used as energy. A larger amount may be thrown off by the birds through enlarging the kidneys and in time a whitish discharge will gather about the vent in high-producing birds.

Protein comes from both vegetable and animal sources. Both are necessary in the poultry ration.

The ultimate products of protein digestion are the *amino acids.* Proteins are fed because of the amino acids they contain. All proteins do not contain the same amino acids, nor are the amounts of similar amino acids the same in different feeds.

There are twenty-three known amino acids involved in nutrition. Eleven of these are essential for chickens. Others are classed as unessential since the body can manufacture them. It is not yet known which amino acids are essential for the various life functions, such as best egg production.

Neither is there complete data concerning the amount and kind of amino acids in various proteins.

Since individual feeds may contain more than one protein, the problem is even more complicated. Many different proteins of varying amino acid relations make up the body. To balance a ration from the protein and amino acid standpoints, we should know the amount and kind of amino acids needed by the bird and their content in various proteins in the different feeds. This information is still incomplete. Hence, a poultry ration should consist of proteins from a variety of sources in the hope that the birds may get the amino acids they require.

It is known that animal proteins contain more of the essential amino acids. Hence, their very great importance in the ration.

Carbohydrates include two classes of substances, fiber and nitrogen-free extract.

Fiber is the woody portion or cellulose tissue of plants. In the fowl, the fiber is digested only in a slight degree and apparently in the caeca, probably the result of bacterial action. By distending the intestines it allows the digestive juices to act more readily. From 3.5 to 7.5 per cent of the entire ration is ample.

Nitrogen-free extract is used by the body for fuel, which furnishes energy and heat. Any excess is stored as fat. Nitrogen-free extract is made up mostly of starches and sugars.

Fat has the same function as the nitrogen-free extract, in that it furnishes energy and heat, and in that, if more is supplied than is needed for this purpose, the excess is deposited as fatty tissue. Fats, however, are more effective than starches or sugars, and give 2¼ times as much energy for each unit of weight.

Protein-energy ratio. This term means the amount of protein in the feed or group of feeds as compared with the combined carbohydrates and fat. When we say a ration has a protein-energy ratio of 1 to 5, we mean that it contains one

part of protein to every five parts of carbohydrates and fat. For egg production a protein-energy ratio of 1 to 4.5 or 1 to 5.5 is desirable.

2. Nutrient allowances for chickens

Modern nutrition involves far more than the protein-energy ratio of the past. Knowledge of vitamins and minerals has

RECOMMENDED NUTRIENT ALLOWANCES FOR CHICKENS IN THE TOTAL FEED CONSUMED *

Nutrients	Amount per pound of feed: Starting chicks	Amount per pound of feed: Laying and breeding hens
Total protein, per cent	20 †	15
Vitamins		
Vitamin A activity (Int. units)	1200 ‡	3300
Vitamin D (A.O.A.C. units)	180	450
Thiamin, mg	0.9	?
Riboflavin, mg	1.6 §	1.3 §
Pantothenic acid, mg	5.0	7.0
Niacin, mg	8.0	?
Pyridoxin, mg	1.6	1.6
Biotin, mg	0.045	0.07
Choline, gram	0.7	?
Minerals		
Calcium, per cent	1.0	2.25 ‖
Phosphorus, per cent	0.6 ¶	0.75
Sodium chloride, per cent	0.5 **	0.5 **
Manganese, mg	25.	15.
Iodine, mg	0.5	0.5

* National Research Council.

† Reduced to 16 per cent by 12 weeks of age.

‡ For growing rations, 1800 Int. units per pound of feed.

§ For growing chicks after 8 weeks of age and for laying hens, 0.9 mg.

‖ Need not all be mixed in feed when calcium supplements are fed free choice.

¶ Two-tenths per cent of total feed should be non-phytin or inorganic phosphorus.

** Represents added sodium chloride and may be iodized salt to supply iodine allowance.

progressed until definite allowances for many of these essential ingredients are known, listed, and used in formulating complete rations.

The National Research Council has established the amounts. They have become the standard.

The term "allowances" includes the requirements and a margin of safety of 66 per cent for vitamin A, 45 per cent for vitamin D, and 20 per cent for the water-soluble vitamins.

3. Suggested levels of nutrient allowances for chickens [1]

The following table is a guide to the amount of the nutrients *needed in the mash* in order that when both grain and mash are consumed the allowances on page 122 will have been met.

Since fish oils, alfalfa, and yellow corn products are practically the only ingredients that supply vitamin A activity in poultry rations, these are listed in a separate table.

Information on vitamin D is on page 132.

SUGGESTED LEVELS FOR MASH MIXTURES

Method of feeding	Protein (per cent)	Calcium (per cent)	Phosphorus (per cent)	Vitamin A activity (units per pound)	Riboflavin (mg. per pound)	Vitamin D (A.O.A.C. units per pound)
Starting mash (all mash)	20	1.5	0.8	2000	1.6	360 *
Growing mash (with grain) 8 weeks to maturity	20	1.5	0.8	3000	0.9	†
Laying mash (with grain)	20	2.0	1.2	5000	0.9	900
Breeder mash (with grain)	20	2.0	1.2	5000	2.0	900

* One-half of this amount of vitamin D can be used if starting mash is fed without grain to 8 weeks of age.
† If reared in sunlight, no vitamin D need be fed.

4. Ingredients that supply vitamin A

In formulating rations it will be found desirable to use a quick method of determining the pounds of a certain feed ingredient of known vitamin A activity that will yield the levels needed.

The table below shows, for example, that 250 pounds of alfalfa containing 40,000 units of vitamin A per pound will,

[1] This table and others following, courtesy E. I. Robertson, formerly of Cornell University.

when mixed in a ton of mash, yield 5000 units of A in each pound of feed. Reference to the table of suggested levels, page 123, shows that a laying mash should have 5000 units of vitamin A per pound of feed.

To read the table proceed from the first column to the right and then upward to the figures indicating thousands. A practical example will illustrate the value of the table.

Example

If 100 pounds of alfalfa meal containing 60,000 units of A per pound and 300 pounds of yellow corn are used in a laying

APPROXIMATE AMOUNT OF INGREDIENTS NEEDED PER TON OF FEED TO SUPPLY 1000 TO 7000 UNITS OF VITAMIN A PER POUND OF FEED

Ingredients	Units of vitamin A per pound	Units of vitamin A in each pound of the ton mixture						
		1,000	2,000	3,000	4,000	5,000	6,000	7,000
		Pounds of ingredient necessary to mix in the ton						
Alfalfa products......	20,000	100	200	300	400	500	600	700
	40,000	50	100	150	200	250	300	350
	60,000	34	67	100	134	167	200	234
	80,000	25	50	75	100	125	150	175
	100,000	20	40	60	80	100	120	140
	120,000	16	32	50	64	80	100	120
	140,000	14	28	42	56	70	84	100
Yellow corn..........	3,200	600	1,200	1,800	......	....	......	....
Corn gluten meal.....	6,800	300	600	900	1,200	1,500	1,800	....
Fish oil								
600 per gram.....	270,000	7.5	15.0	22.5	30.0	37.5	45.0	52.5
1,000 per gram.....	450,000	4.5	9.0	13.5	18.0	22.5	27.0	30.0
2,000 per gram	900,000	2.25	4.5	6.75	9.0	11.25	13.0	15.0
3,000 per gram.....	1,350,000	1.5	3.0	4.5	6.0	7.5	9.0	10.0
4,000 per gram.....	1,800,000	1.1	2.2	3.3	4.4	5.5	6.6	7.7

mash, is extra vitamin A needed? If so, how much oil containing 2000 units of A per gram is needed?

Answer: 100 pounds of alfalfa will supply 3000 units of vitamin A per pound of feed, 300 pounds of corn an addi-

tional 500 (since 600 supplies 1000), making a total of 3500. The suggested level for mash mixtures is 5000 units per pound. The extra 1500 units can be supplied by 3.5 pounds (per ton) of a "2000 A" oil.

5. How to calculate the composition of feed ingredients

After completing table, Composition of Ingredients Commonly Used, the nutrients can be converted to a "per pound of feed" basis by dividing by 2000, and can then be compared to the tables, Suggested Levels for Mash Mixtures and Recommended Nutrient Allowances, pages 122 and 123.

The average composition of the ingredients commonly used in poultry feeds has been condensed and, where possible, whole numbers have been used for ease in calculations. Spaces have been provided for the nutrients. To use the table, list the amount in hundreds, or decimal parts thereof, of each ingredient in a ton in the column marked "Pounds used per ton." Multiply the amount of each ingredient by its average composition and enter the result in the appropriate columns. The total for each column is the amount of that nutrient contained in a ton of feed.

Some attention to the fiber content of the entire ration is desirable. It should fall within 3.5 to 7.5 per cent.

6. Further feed factors

(1) *Palatability.* It is well to pay considerable attention to the natural likes and dislikes of hens. Fowls are natural grain eaters, and we make use of this liking on the part of the bird in our feeding practice. Feeds must be palatable to insure a large consumption of them.

Hens like to eat corn, wheat, oats, cornmeal, ground oats, meat scrap, gluten feed, and milk; but such feeds as blood meal, cottonseed meal, alfalfa meal, and oil meal are less palatable and should be avoided or greatly restricted in the ration.

COMPOSITION OF INGREDIENTS COMMONLY USED IN POULTRY RATIONS *

Ingredients	Lb. used per ton †	Protein		Calcium		Phosphorus		Riboflavin		Mg. per pound			
		Lb. in 100 lb.	Lb. in a ton	Lb. in 100 lb.	Lb. in a ton	Lb. in 100 lb.	Lb. in a ton	Mg. per lb.	Mg. in a ton	Manganese	Pantothenic acid	Niacin	Thiamin
Alfalfa meal		16		1.4		0.2		6		12	17	18	2
Alfalfa leaf meal		20		1.4		0.2		8		14	18	24	3
Barley		13		0.1		0.3		1		7	3	30	3
Bone meal, steamed		6		27.0		13.2		0		1	0	0	0
Brewer's yeast, dried		46		1.3		1.2		20		1	60	217	31
Buckwheat		10		0.1		0.4		1		..	..	..	..
Buttermilk, dried		34		1.3		0.9		15		..	20	8	1
Corn		9		....		0.3		1		2	3	6	2
Corn gluten meal		43		0.1		0.5		..		2	6	14	..
Cottonseed meal		41		0.2		1.1		4		8	6	20	6
Dicalcium phosphate		0		23.0		17.0		0		0	0	0	0
Fish meal, menhaden		58		6.5		3.6		2		20	..	..	..
Fish meal, sardine		68		4.7		2.6		3		18	..	..	..
Limestone		0		39.2		0		0		91	0	0	0
Meat scrap		55		8.7		4.3		3		8	4	..	..
Meat and bone scrap		50		10.5		5.2		3		5	5	31	..
Oats		12		0.1		0.4		1		15	5	7	3
Oyster shell		0		38.0		0		0		0	0	0	0
Peanut meal		45		0.2		0.6		2		..	24	78	3
Rice bran		13		0.1		1.8		1		127	10	129	10
Soybean meal, expeller		41		0.3		0.7		2		14	6	18	3
Soybean meal, solvent		44		0.3		0.7		..		14	..	..	..
Skimmilk, dried		36		1.3		1.0		9		..	15	7	2
Wheat		12		0.1		0.4		1		17	6	27	2
Wheat bran		16		0.1		1.1		1		54	11	140	3
Wheat standard middlings		17		0.1		0.9		1		54	7	53	7
Whey, dried		13		0.7		0.7		13		6	24	8	..
Total		xxx		xxx		xxx		xxx		xxx	xxx	xxx	xxx
Per pound of feed													

* More complete tables giving the average composition of feeds, vitamin A, and amino acid content of poultry feeds will be found in *Feeding Poultry*, by G. F. Heuser, published by John Wiley & Sons, 1946.

† Example: Assume 200 lb. alfalfa meal and 50 lb. buckwheat in the ration. List in Col. 1, as

Alfalfa meal 2.00
Buckwheat 0.50

Multiply by 16 and 10 respectively and enter 32. and 5. in the "lb. in a ton" column.

The feeds that are most palatable are usually most digestible, because of their greater stimulation of the digestive juices.

(2) *Wholesomeness.* Musty or decayed feeds may cause serious troubles. It is recommended that only high-grade, clean, wholesome feed be used, as the poultry keeper cannot afford to take chances with any other.

(3) *Variety.* Hens are creatures of habit, and although they prefer a variety of feed, they do not like sudden changes in the ration. To provide variety in feeds, thus stimulating the appetite and increasing the consumption, the most satisfactory rations are made up of several kinds of feeds.

It is desirable that the mash mixture contain six or more ingredients, at least two being the source of the animal food. The grain mixture should contain at least two grains and preferably more. Oats, buckwheat, and other grains high in fiber should not make up more than 35 per cent of the grain mixture.

(4) *Mechanical condition.* Fowls do not like very hard, extremely small, or very large kernels. They cannot consume enough of the too bulky feeds, because birds must have their feed in a fairly concentrated form.

Feeds that are sticky when mixed with water or milk should be limited in the ration so that, when used with bulkier feeds, they will be more readily consumed by the birds.

(5) *Medicinal effect.* Certain feeds are laxative and valuable in keeping the digestive tract open. Such feeds are linseed oil meal, milk, and wheat bran. Cotton seed meal is constipating and should be used sparingly, if at all.

(6) *Effect on quality of product.* Some feeds have an effect on the flavor, odor, and color of eggs or meat. Green legumes, kale, sprouted oats, and yellow cornmeal give a deep yellow color to the yolk of eggs; whereas wheat, oats, buckwheat, white corn, and beets tend to give a light-colored yolk.

The flavor of eggs is sometimes affected by onions or fish scrap, and occasionally by cabbage and rape.

The flavor of poultry flesh is affected by celery, onion, garlic, and fish.

(7) *Availability.* On many farms, where homegrown feeds are available, one may find it practicable to utilize certain of them. In this way a ration may be compounded which may be less expensive than would be the case if a particular feed were to be sold and something else purchased. For example, oats, buckwheat, kafir corn, and other feeds may be used more freely when they are cheaper in price and available at home or in the local market.

A mash of homegrown, ground feeds with animal feeds added gives good results.

150 pounds ground corn
150 pounds coarse ground wheat
100 pounds fine ground oats or barley
75 pounds meat scrap
25 pounds dried skimmilk

When liquid skimmilk or buttermilk is available, omit the dried skimmilk and reduce the meat scrap to 50 pounds.

A grain mixture:

50 pounds oats, buckwheat, and barley
50 or 100 or 150 pounds wheat
150 or 100 or 50 pounds corn

(8) *Cost.* The best feed, of course, is the one that gives the most economical return. The cost of feeds, however, differs greatly in different sections of the country and at different seasons of the year. The cost of a feed is not always in proportion to its value for poultry feeding; other market demands may be governing factors in determining its market value. The demand for buckwheat, oats, or wheat for human consumption may make the price of these grains almost, if not quite, prohibitive. One is justified in making changes in the kinds of feed in a ration when it is economical to do so. The feeding value of the ration should not be lowered because of cost.

The laying rations in use by successful poultrymen and recommended by various experiment stations differ. It is not likely that all conditions and factors entering into the make-up of a poultry ration would be similar, except in one locality. In certain fundamental factors all agree; in other, less essential factors they differ. What is entirely practicable for one may be decidedly impracticable for another. Thus we find that there is no one best ration.

(9) *Danger in excess or deficiency of any food nutrient.* If the ration is deficient the bird may draw upon its body reserves, suffering a loss in body weight and later in production. An excess may prove injurious to the health as the bird must either deposit or eliminate it. Some freedom of choice of feeds is desirable even with the best-balanced rations.

7. The importance of vitamins in feeding poultry

Vitamins are absolutely essential for growth, reproduction, and maintenance of health. Without them no poultry ration is complete. Their discovery has made the poultryman less dependent on outside weather conditions as chicks can be reared indoors quite satisfactorily, and keeping layers confined to their houses, through the entire laying year, is rapidly becoming a universal practice. Vitamins are found in foodstuffs in very small quantities. Whenever there is a prolonged deficiency in the food of any of the vitamins, animals usually develop a characteristic deficiency disease.

Up to the present time many vitamins and factors have been discovered. In the practical feeding of poultry attention should be given to three vitamins, A, D, and riboflavin. Other vitamins are essential, but are seldom in insufficient supply when the ration is adequate otherwise.

A poultry ration is considered adequate in the known vitamins if it contains a liberal amount of yellow corn, wheat, wheat by-products, milk by-products, feeding oil, or other satisfactory vitamin D carriers (during confinement), and alfalfa meal of a good grade.

Vitamin A. A partial deficiency of this vitamin for a long time results in slow growth and increased mortality. Production is lowered. A serious deficiency of vitamin A frequently causes the eyelids of chickens to become granular and sticky and creamy white pustules or cankers may occur in the roof of the mouth and down the esophagus. An excess deposit of urates may also be found in the kidneys so that these organs appear nearly white in color.

The extreme form of vitamin A deficiency is sometimes called nutritional roup. It can be distinguished from ordinary colds by the absence of the customary vile odor.

When there is an excess of vitamin A in the feed over a period of time, it can be stored in the body so that a deficiency will not appear until several months of feeding a low vitamin A ration have passed.

A deficiency should not occur in poultry feeding. Vitamin A will be amply provided for layers and breeders if the ration contains feeding oil, alfalfa meal, and yellow corn.

Vitamin A is obtained by animals from carotene, which is abundant in feeds containing yellow pigments called xanthophyll. The xanthophyll-bearing feeds, however, tend to darken the yolks and should be fed in limited amounts. Sources of carotene in feeds for poultry are the following:

Feeds Containing both Carotene and Xanthophyll	Feeds Containing neither Carotene nor Xanthophyll	Feed Containing Carotene, but No Xanthophyll
Green cabbage leaves	White cabbage leaves	Carrots
Yellow corn	White corn	
Alfalfa leaf meal	Mangels	
Growing green feeds as:	Wheat	
Alfalfa	Oats	
Clover	Barley	
Grass	Buckwheat	
Oats		
Rye		
Rape		

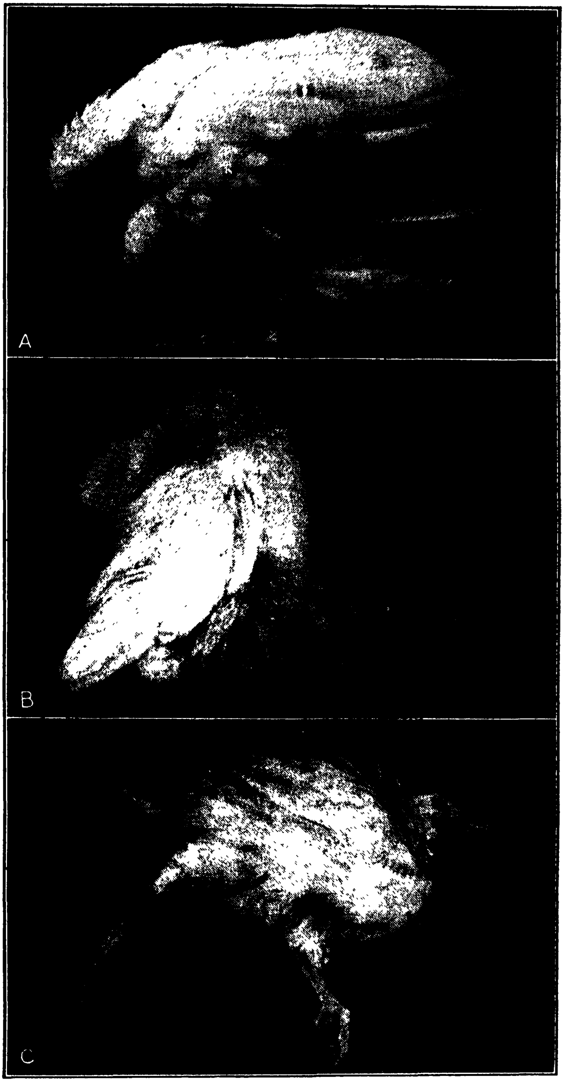

Fig. 65. Effects of vitamin deficiencies in chick rations. *A*. A young White Leghorn cockerel in the last stage of vitamin-A deficiency. *B*. Symptoms of vitamin-B (thiamin) deficiency. *C*. Nutritional encephalomalacia, or the crazy chick disease. Courtesy of Dr. L. C. Norris, Cornell Univ.

Vitamin D. Vitamin D is required to aid the birds' proper assimilation of calcium and phosphorus. Its absence from the ration causes the bones of young chicks to fail to harden, and a deficiency disease called rickets develops within a few weeks. It is accompanied by beading of the ribs, crooked breast bones, and pliable, easily twisted beaks. Rickets result from the inability of the bird to deposit the proper amount of calcium and phosphorus in the bones. Vitamin D is necessary also for egg production and hatchability and helps to prevent the occurrence of thin-shelled eggs. The ultraviolet light of sunlight is an effective substitute for the D vitamin as both assist the bird in utilizing the calcium. However, these ultraviolet rays do not pass through ordinary window glass. Special glazing materials can be used which allow a proportion of these rays to pass through. They must be kept clean, as dirt prevents passage of ultraviolet rays. If curtain fronts are used, they should be opened on all favorable days during the winter. Even the small amount of ultraviolet light rays in the sun and atmosphere assists in strengthening egg shells.

Vitamin D is easily supplied by using feeding oils or D-activated animal sterols.

Pullets reared out-of-doors are able to store enough vitamin D to last several months.

Riboflavin is necessary for chick growth. It must be present in breeder rations to permit proper embryo growth and livability. It is required by growing chicks.

Its absence causes low hatchability, slow growth, high mortality in young stock, and a leg paralysis causing chicks to walk on their hocks with the toes turning inward.

The chief sources of riboflavin for poultry feeding are milk by-products, alfalfa meal, and distiller's solubles.

Other essential vitamins present under conditions of practical poultry keeping follow:

Vitamin B_1 or thiamin. A deficiency of vitamin B_1 in the ration results in loss of appetite and vigor, and emaciation.

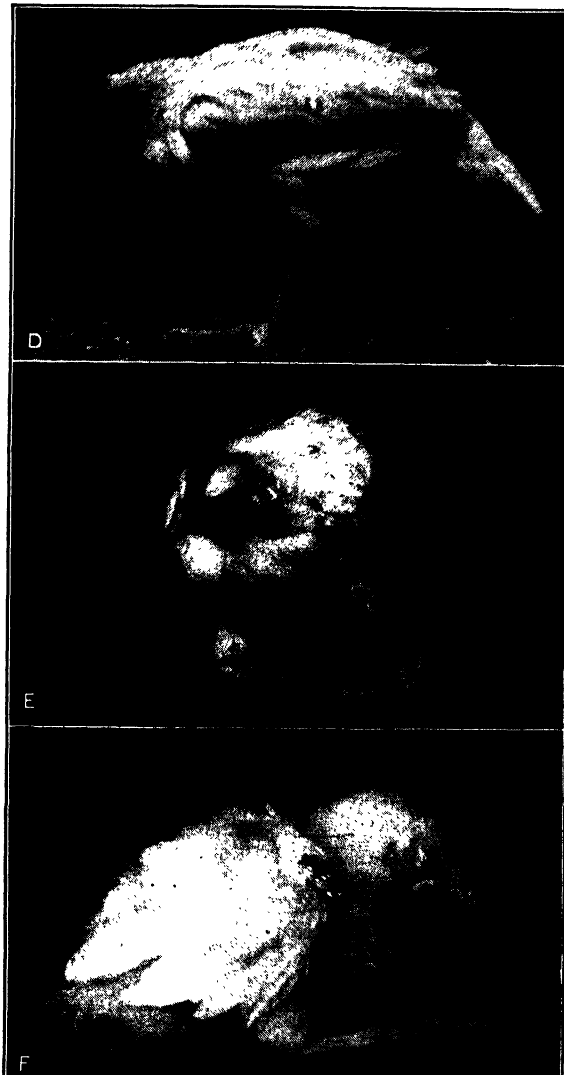

Fig. 66. Vitamin deficiencies. *D*. A young White Leghorn cockerel suffering from rickets (vitamin-D deficiency). *E*. Nutritional leg paralysis resulting from riboflavin deficiency. *F*. Dermatosis, a result of a deficiency of the anti-dermatosis vitamin (pantothenic acid). Courtesy of Dr. L. C. Norris, Cornell Univ.

The disease is known as polyneuritis. Fowls in the final stage of this disease frequently will pass into violent convulsions when suddenly disturbed.

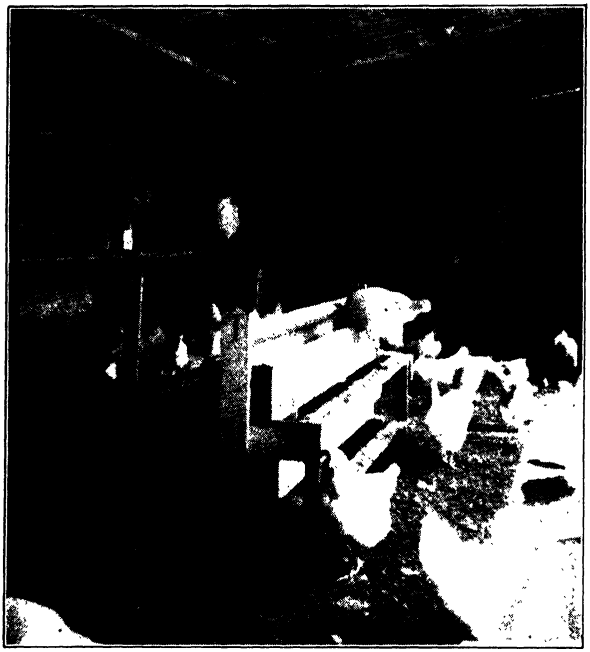

FIG. 67. An abundance of sunlight entering the house through open spaces provides ultraviolet rays which supplement the vitamin D in the ration. A complete substitute for such sunlight in its beneficial effects on poultry is yet to be found.

Large quantities of vitamin B_1 are found in all unprocessed cereals.

Pyridoxin or vitamin B_6. The symptoms of a deficiency of this vitamin are reported to be slow growth, depressed appetite and inefficient utilization of food, followed in some cases by spasmodic convulsions and death. An abnormal, jerky gait is occasionally shown. The symptoms resulting from a deficiency of vitamin B_6 are apparently somewhat similar to those caused by a deficiency of vitamin B.

Ascorbic acid or vitamin C. Vitamin C prevents scurvy. But hens are not subject to scurvy. However, the vitamin has been found in certain of the internal organs of hens. Presumably, then, hens are able to synthesize all that they require.

Vitamin E. This vitamin is required for successful reproduction in chickens. A lack of it for a prolonged time in the feed produces permanent sterility in the male and temporarily lowers hatchability in the female. It is difficult to prepare rations from the usual feeds which do not contain adequate amounts of vitamin E. At Cornell and other stations, attempts to cure range paralysis or neurolymphomatosis by the use of vitamin E have failed. However, claims of such cures have been made for this vitamin.

Vitamin E deficiency in chicks causes nutritional encephalomalacia. This disease is occasionally found in the field. It results in difficulty in walking, loss of balance, tremors, retraction of the head and jerking of the legs. It is sometimes called crazy chick disease. A total of 5 to 8 per cent of alfalfa meal may be added to chick mashes should the trouble become serious in any season.

Vitamin E is very stable in feeds except in the presence of rancidity or oxidative reactions in feeds. However, freshly milled products moving fairly rapidly to poultry farms reduce this possibility.

Vitamin K is not necessary for growth. Its absence prevents normal clotting of the blood. The vitamin is found in large amounts in alfalfa meal, and in meat scrap and fish meals that are not fat extracted. Hence, it is not a field problem. One per cent of dehydrated alfalfa gives protection.

Pantothenic acid is found in cane molasses, liver meal, yeast, wheat bran, and milk and its by-products. Its absence causes low hatchability, chick dermatosis or chick pellegra (crusty scabs at the corners of the mouth and thickened and cornified skin on the bottoms of the feet). The eyelids become granular and sometimes stick together.

There should be little, if any, trouble when chick mashes contain a reasonable amount of milk and alfalfa.

However, all such conditions occurring in the field are not of nutritional origin.

Biotin, choline, folic acid, factor S, and inositol though important are not significant practically since they are found in usual feedstuffs.

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CHAPTER VII

ANATOMY AND PHYSIOLOGY OF THE DOMESTIC FOWL

It is human nature to desire to take things apart and see how they are made. The poultryman is fortunate in being able to satisfy this desire, since a chicken, which is a small individual, and usually one of a large number, may be killed, examined, and later used for food. In this way no loss is occasioned, while some interesting and valuable information may be obtained. Some knowledge of the anatomy of the fowl, and of the functions of the various parts and their relation and importance to many recognized practices of poultry management, is of practical value to the poultryman. Moreover, the division of labor among the various organs and the intricate interlocking and relationship of the many muscles, bones, blood vessels, etc., furnish a most amazing example of the coordination of parts and functions.

Operations:

Studying various parts of the bird's body, as follows:

1. A feather.
2. The feather tracts.
3. The head.
4. The brain.
5. The muscular system.
6. The respiratory system.
7. The circulatory system.
8. The digestive system.
9. The reproductive system.

10. The excretory system.
11. The skeletal system.

1. A feather (Fig. 68)

All feathers are formed on the same general principle, but they differ in size, shape, and rigidity. A large feather is most

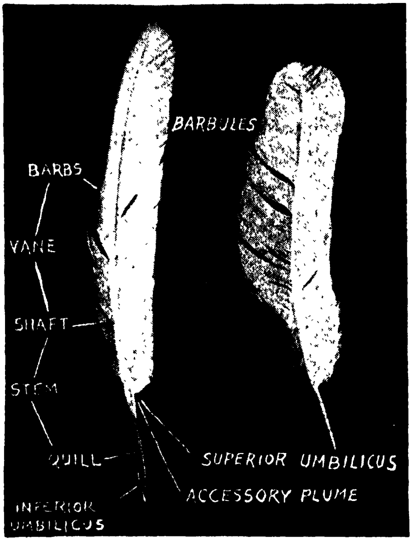

FIG. 68. Parts of a feather.

easily studied. Secure a primary or secondary feather from the wing, or one of the stiff, main tail feathers, and find the following parts:

A. The stem. This is the main part of the feather and consists of two parts, the quill and the shaft.

B. The quill. This is cylindrical and hollow, and makes up the base of the feather. It is filled with a parchment-like material called pulp. In new feathers the quill is filled with blood. This fact is used to determine whether or not a hen has new feathers.

C. The shaft. The remaining part of the stem is called the shaft. It is grooved on the under side, and therefore has great strength in proportion to its weight.

D. The vane. This comprises the shaft and the barbs attached to it. It provides a wide, tight, flat surface for protection to the body and for use in flight.

E. The barbs. The long, slender parts, projecting at right angles to and from either side of the shaft, are called barbs. The barbs and their barbules are sometimes referred to as the web of the feather. The barbs may be easily seen and appear to be stuck together.

F. The barbules. Along the sides of the barbs, and at right angles to them, are smaller processes called barbules, which bear hooklets. These hooklets hold the adjacent barbs together and are responsible for the resistance offered when the barbs are separated.

G. The inferior umbilicus. This is a small hole in the lower end of the quill through which the blood enters to nourish the feather.

H. The superior umbilicus. This name is given to a small opening at the junction of the quill and shaft at the point where the quill emerges from the skin. The superior umbilicus connects the interior of the quill with the outside air.

I. The accessory plume. A small growth, which in some cases resembles a feather and in other cases is rudimentary and consists merely of down, is attached to the under side of the feather at the base of the shaft. This growth is called the accessory plume. It partly covers the superior umbilicus. It appears only on old feathers and hence serves a useful purpose in distinguishing old feathers from the new.

2. The feather tracts

In several sections of the body, the feathers are developed in compact formations extending over definite areas. These areas may best be seen by killing a fowl and studying the skin. The feather tracts are indicated by raised portions of the skin

on which are the scars, or feather follicles. The feather tracts are located where they provide the greatest protection to the body.

When dry-picking poultry for market, the feathers on the feather tracts should be removed promptly, since tearing is likely to occur if the skin cools (Chapter XV).

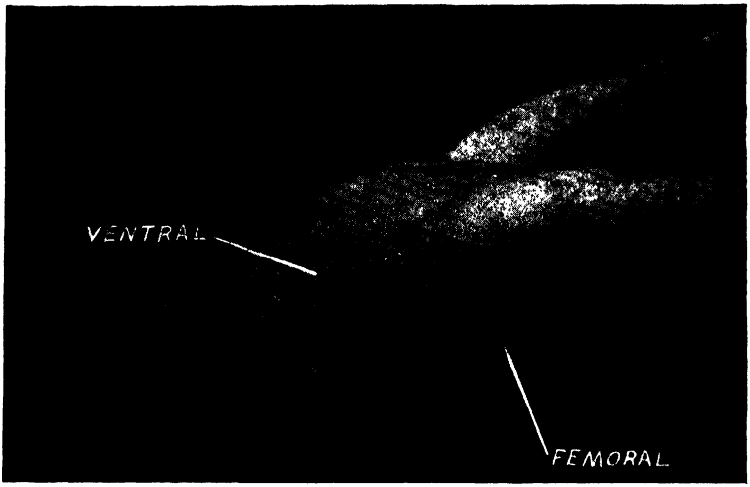

FIG. 69. The feather tracts.

Observe the following feather tracts:

A. The ventral tract. This extends the entire length of the body on the under side, passing from the head along the neck to the breast, where it divides and passes on either side of the keel bone to the cloaca. Throughout the greater part of its length, it is separated from the spinal tract by featherless spaces, one on either side of the trunk and neck (Fig. 69).

B. The femoral tract. This is a triangular tract of considerable size, on the thigh (Fig. 69).

C. The humeral tract. On the upper arm of the wing, and close to the back, this narrow strip runs crosswise of the wing. The wing coverts grow in the humeral tract.

The ventral, femoral, and humeral tracts are those most likely to tear in the process of dry-picking. There are other tracts of somewhat minor importance.

3. The head (Fig. 70)

An examination of the external head reveals the following parts:

A. The upper and lower mandibles. These form the beak, and are especially designed for picking or tearing food.

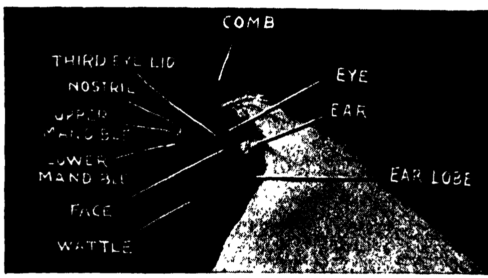

FIG. 70. The head.

B. Two nostrils. These are oblique slits, one on either side of the upper beak.

C. The eyes. Each eye has three lids.

(1) The upper and (2) the lower lids are easily seen. The upper lid moves slightly; the lower lid moves upward, covering almost the entire eye when closed.

(3) The inner, or third, lid is a white, transparent membrane, which moves with great rapidity and diagonally across the eye, starting from the upper front section of the eye socket.

Hold a live bird quietly and, with the tip of a soft feather, carefully touch the eyeball. The inner lid will quickly pass over the eyeball.

On a dead bird, this lid is seen as a whitish material in the corner of the eye. With a pencil point it may be moved out and across the eye.

D. The ear opening. This opening is covered for protection by a cluster of small, stiff feathers. It lies behind and slightly below the eye.

E. The comb. The fleshy growth at the top of the head is called the comb; like the earlobes and wattles, it is a secondary sexual character, the function of which appears to be sex attraction.

FIG. 71. The brain. Longitudinal section of the head of a high-producing White Leghorn hen.

F. The earlobes. These are the oval, fleshy growths on the face, back of and below the ear openings.

G. The wattles. These are attached to the under side of the throat and the lower beak.

H. The face. All the fleshy, nearly featherless area around the eye is included in the face.

4. The brain (Fig. 71)

In order to study the location of the more important parts of the brain, remove the comb and skin from the top of the head and, with a heavy, sharp knife and a hammer, cut

through the center of the head lengthwise. If the cut is made directly through the middle, the brain should be easily seen.

A. The cerebrum. This is a large, bilobed section of the brain, lying in the upper part of the skull. It is somewhat heart-shaped.

B. The cerebellum. This is an oval body lying just below and back of the cerebrum. When the cerebellum is cut lengthwise, the inner cut surface shows several whitish lines radiating from a whitish center.

C. The medulla oblongata. This is the rather thick, wide body lying just under the cerebellum and at the upper end of the spinal cord. It is the connecting link between the other parts of the brain and the spinal cord, and, through the cord, it connects the brain with the rest of the body.

Either the cerebellum or the medulla must be pierced with the knife when the stick for drypicking is made, in order to make the muscles relax their grip on the feathers. Piercing the cerebrum will kill the bird, but will not loosen the feathers.

Place a knife on the half of the head, and observe that the point must be directed low down at the base of the skull if the proper result is to be secured when sticking for drypicking (Chapter XV, Sticking and Debraining).

5. The muscular system

With a sharp knife or scalpel, cut through the skin from the corner of the mouth down the side of the neck, and along the keel to the vent. Remove the skin from one side of the bird, from the keel to the middle of the back. Use the fingers as much as possible while doing this, and do not cut the flesh. Several important muscles should now be seen.[1]

A. The major pectoralis. This is the large breast muscle used to pull the wing down in flight. It reaches from the rear of the keel down and over the wishbone. Start at the base of

[1] For a more complete discussion of the many muscles comprising the bird's body, the reader is referred to *Anatomy of the Domestic Fowl,* by Kaupp.

the keel and, with the fingers, loosen this large muscle (Fig. 72). It lies on, but is separated from, a muscle just beneath.

B. The minor pectoralis. This is located below the major, and is used to raise the wing in flight. It lies in the angle formed at the junction of the keel with the body skeleton (Fig. 72).

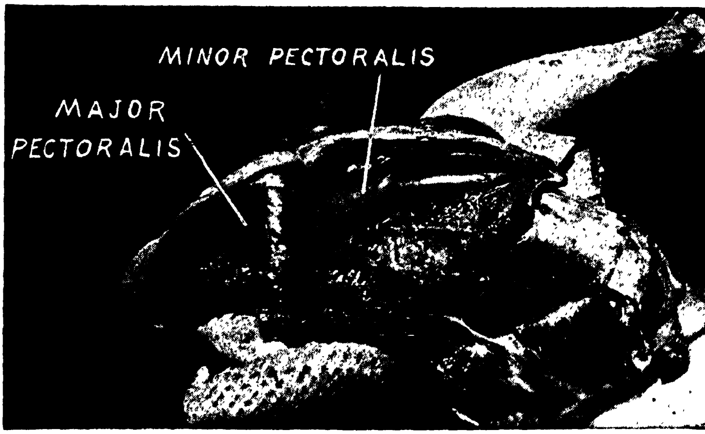

FIG. 72. The breast muscles.

C. The biceps. The muscle located on the inside of the humerus or upper arm, and used in closing the wing, is called the biceps.

D. The triceps. This is a muscle located on the outside of the humerus or upper arm. It opens and spreads the wing, its action being the reverse of that of the biceps.

E. The gastrocnemius. The large muscle at the rear of the tibia, or drumstick, is the gastrocnemius. It is larger at the upper end. It raises the tibia and extends the shank, or metatarsus.

On the front of the drumstick are several muscles and tendons which move the shank and toes.

By carefully removing the large outer muscle of the thigh and drumstick, other muscles and tendons will be observed.

Their uses can be studied by pulling on them, and noting the action of the leg and toes. Note the way the bending of the leg when the bird is at rest on the roost causes the toes to grip the perch.

6. The respiratory system

Remove the sternum or breastbone (Fig. 108). Insert the knife under the skin near the breast, and run it up the neck. Lay the skin back on the neck, thus exposing the windpipe and the esophagus, or food pipe. The head has already been split to facilitate the study of the brain.

The respiratory system may now be seen, and may be traced from the nostril through to the end of the lungs. The respiratory system, starting from the nostril, consists of (*A*) nostrils, (*B*) pharynx, (*C*) upper larynx, (*D*) trachea, (*E*) lower larynx, (*F*) bronchi, (*G*) bronchial tubes, (*H*) lungs, and (*I*) air sacs (Fig. 73).

A. The nostrils. Examine the nostrils and the nasal chambers, and observe their proximity to the eye.

B. The pharynx. The pharynx is the part of the roof of the mouth, at the rear, on which is a row of horny projections. It is located where the soft palate is found in other animals.

C. The upper larynx. This is the opening at the upper end of the trachea at the base of the tongue.

D. The trachea. The trachea, or windpipe, is made up of cartilaginous and bone-like rings, conected by muscular tissue. It extends from the upper larynx to the lower larynx.

E. The lower larynx. At the lower end of the trachea, the pipe divides; it is at this point that the lower larynx is located. The true organ of voice is contained in the lower larynx.

F. The bronchi. The lower trachea divides into two parts or tubes, one going to the right lung and the other to the left lung. These tubes, or bronchi, are provided with incomplete cartilaginous rings.

G. The bronchial tubes. When the bronchi enter the lungs, they immediately change their form, and divide and subdivide, forming the bronchial tubes.

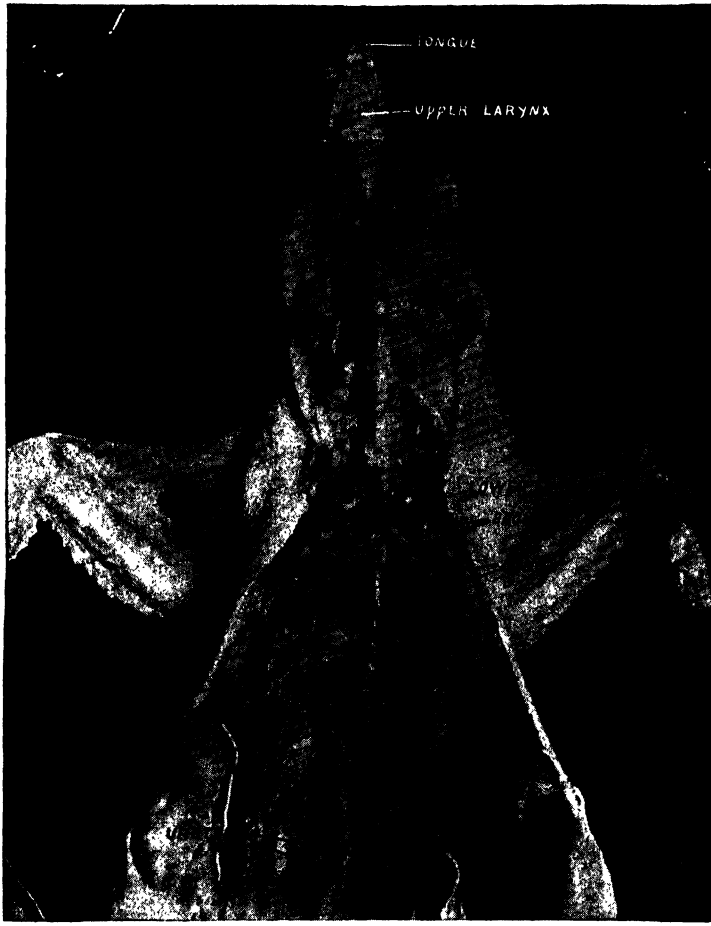

FIG. 73. The excretory and respiratory systems.

H. The lungs. The lungs are pinkish or reddish organs, one on either side of the body. They lie imbedded between the ribs, extending downward from a point near the back. By carefully moving the internal organs near the front of the body cavity to one side, with the fingers, one may expose the lungs to view.

I. The air sacs. Roll a piece of paper or make a tube from a large quill, insert it into the trachea, and blow into it. If the air sacs have not been destroyed, one or more of the nine air sacs may be inflated.

These sacs communicate with the interior of the bones. Kaupp states that, while not communicating with one another, they are so formed that they may be partly inflated, thus making the body of birds lighter for flight.

7. The circulatory system

Carefully moving the organs near the heart, observe the arteries and veins which extend from the heart to various parts of the body.

The circulatory system of birds is very similar to that of mammals. The heart consists of two auricles and two ventricles. The impure blood passes from the right auricle to the right ventricle, and from there through the pulmonary arteries to the lungs. Purified blood returns to the left auricle, through the pulmonary veins, and passes from the left auricle to the left ventricle, and from there through the aorta to the body. Impure blood returns to the right auricle, completing the cycle.

8. The digestive system (Fig. 74)

Carefully remove the entire digestive system, starting at the mouth by loosening the tongue and the food pipe, or esophagus, and then the crop. Then lift out the liver, gizzard, intestines, etc., after loosening them from the body walls. Finally, cut around the vent.

Lay the entire tract on the table and note the various or-

gans. The following organs should be seen in order. It will be found interesting to measure the length of each section.

A. The tongue. The tongue is normally attached to the back part of the floor of the mouth.

B. The esophagus. This is the tube through which food travels from the mouth to the crop, and from the crop to the proventriculus.

C. The crop. The crop is an enlargement of the esophagus, and is used for storing and softening the food. Food is gradually sent along to the stomach as needed, by contraction of the walls of the crop.

D. The proventriculus. Two or 3 inches beyond the crop, an enlarged muscular portion of the esophagus will be seen, about ½ to ¾ inch in diameter and from 1¼ to 2 inches long. This is the proventriculus. On the inner surface are the openings of various glands, which secrete gastric juice and some acids. These liquids are mixed with the food and assist in the further softening of it.

E. The gizzard. The gizzard is heavily muscled, reddish green in color, and located just back of the proventriculus. Probably some gastric digestion takes place in the gizzard, but this organ functions chiefly in crushing and grinding food. It is the largest single organ in the body.

The gizzard is a powerful muscle. Lippincott says, "It has been stated that iron tubes capable of supporting a weight of 535 pounds have been completely flattened out by passing through the gizzard of a turkey."

F. The duodenum. Leaving the gizzard, near the point at which it entered, the digestive canal continues, forming a fold immediately after it leaves the gizzard. This loop, or fold, of the intestine is the duodenum, which supports the pancreas.

Gastric digestion, together with some pancreatic digestion, takes place in the duodenum.

G. The pancreas. The pancreas is the long, flesh-colored organ lying between the folds of the duodenum. It empties the pancreatic juice into the small intestines.

H. The liver. This is a large, several-lobed, dark red organ. It is more or less flat, becoming quite thin at the extremities. It is the largest gland in the body. The liver secretes the bile.

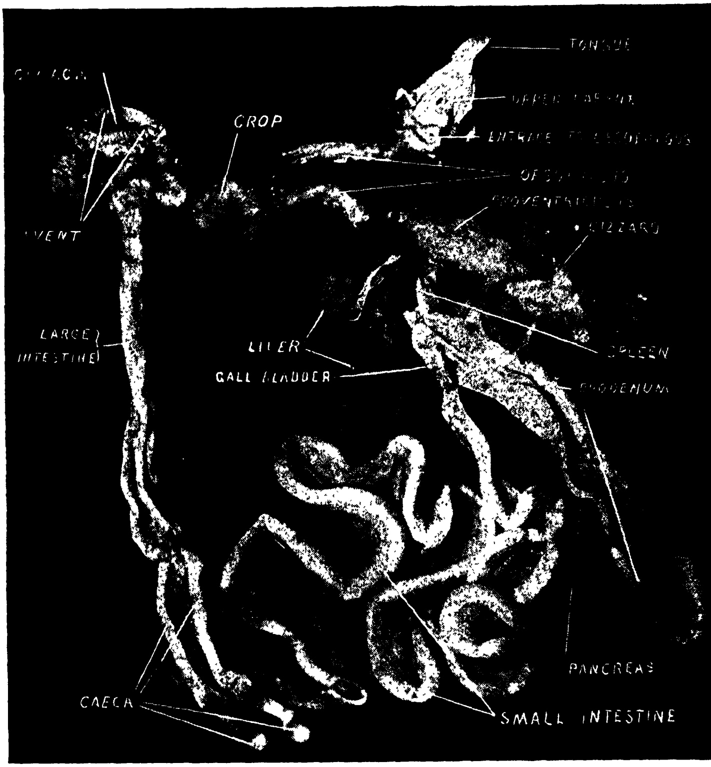

FIG. 74. The digestive system.

It is supposed that certain foods, such as sugar, are stored here by the blood, and that at least some of the uric acid is formed here and passed on to the urine.

I. The gall bladder. Partly imbedded among the folds of the liver is an elongated, greenish organ, the gall bladder. Some of the bile is stored in the gall bladder. The bile is a

fluid which helps in the digestion of the fats contained in the food. A duct leads from the gall bladder to the upper end of the duodenum.

J. The spleen. This round, reddish body is found near the liver. It is usually from ¼ to ½ inch in diameter. Its function is little known. Some authorities believe that the white corpuscles of the blood are accumulated in the spleen, and rebuilt or cast from the body.

K. The small intestine. The small intestine includes both the duodenum and the remaining portion of the digestive tube, from the gizzard to the caeca. It is about 2½ feet long in the average bird. The inner surface is lined with minute villi, which may be seen by washing under water.

Pancreatic digestion, together with the emulsifying of fats by the bile, takes place in the upper end of the small intestine. Absorption, by the blood, of nutrients contained in the food mass takes place throughout the entire length.

L. The caeca. At the junction of the small and large intestines are two branches, 5 to 7 inches in length. These open into the intestine at one end, but have no outlet at the other.

Because of this, they are sometimes called "blind guts." Their function is not definitely known. They appear to serve as temporary storage organs for fecal material, and some absorption may take place in them.

M. The large intestine, or rectum. That part of the tract between the caeca and the cloaca corresponds to the large intestine in other animals, and is more widely known as the rectum in poultry.

Kaupp states that digestion and absorption may continue in the large intestine.

N. The cloaca. The rectum terminates in a short, sac-like organ, slightly larger in diameter. This is the cloaca, and it is here that the ureters deposit the urine from the kidneys. The urine and the solid waste material in the large intestine are mixed together in the cloaca. The oviduct also opens into the cloaca.

The alimentary canal ends at the vent.

FIG. 75. Female reproductive system of a White Leghorn hen in heavy production.

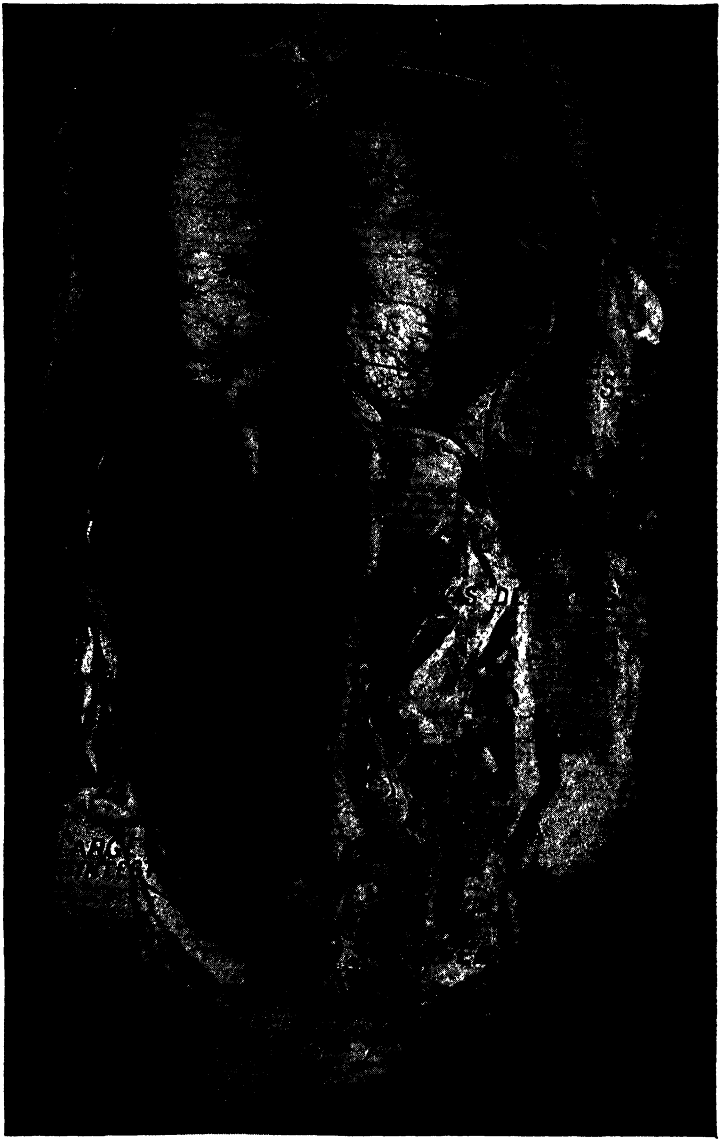

Fig. 76. Male reproductive system.

9. The reproductive system

In the female, the ovaries and oviduct may be seen after the digestive system is removed (Fig. 75). (See Chapter XX for illustrations and description of the system and its function.) The reproductive system of the male includes the following organs:

A. The testes (Fig. 76). In the male, the two light-colored testes will be seen lying on either side of the back, near the center of the body.

B. The vas deferens (Fig. 76). From the testes, the vas deferens extends along the kidneys and to the outside of the ureter, finally ending in the upper wall of the cloaca. Its function is to carry the seminal fluid.

10. The excretory system (Fig. 73)

This system consists of the kidneys and the ureters.

The kidneys are a pair of convoluted, three-lobed, dark red bodies, firmly imbedded among the bones along the spine and extending from the lungs well to the rear.

The ureters are a pair of tubes connecting the kidneys with the lower part of the cloaca. The urine is passed through the ureters to the cloaca, where it is expelled with the feces. The white, chalk-like deposit frequently seen in the voidings is due to urates, and is not, as sometimes believed, a deposit of lime.

11. The skeletal system

The structure of the bones of poultry is quite similar to that found in other animals, except that many of the bird's bones are hollow.

In the baby chick, many of the future bones consist of cartilage, which becomes hardened into bone as the chick grows older. This fact is sometimes used in determining the age, as the rear end of the keel does not harden, and may be bent, until the bird is nearly one year old.

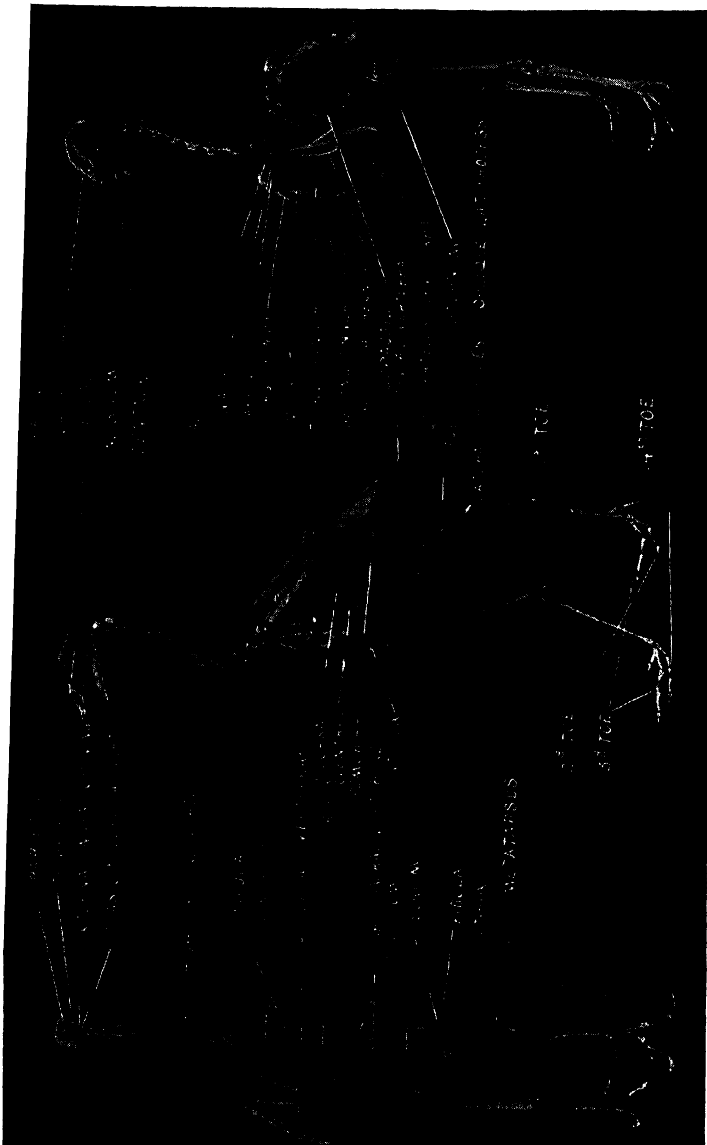

FIG. 77. Skeleton of the domestic fowl.

For names and location of the bones, see Fig. 77.

Kaupp[1] gives the following divisions of the skeleton:

- The Axial Skeleton
  - Skull
    - Cranium
    - Face
  - Vertebral Column
    - Cervical Region
    - Dorsal Region
      - Ribs
      - Sternum
    - Lumbar Region
    - Sacral Region
    - Coccygeal Region
- The Appendicular Skeleton
  - Shoulder Girdle
    - Scapula
    - Coracoid
    - Clavicle
  - Fore Limb
    - Arm—Humerus
    - Forearm
      - Radius
      - Ulna
    - Hand
      - Carpus
      - Metacarpus
      - Phalanges
  - Pelvic Girdle (Hip Bone)
    - Ilium
    - Ischium
    - Pubis
  - Hind Limb
    - Thigh—Femur
    - Leg
      - Tibia
      - Fibula
    - Foot
      - Metatarsus
      - Phalanges

Secure a skeleton and identify the bones comprising the skeletal system by referring to the illustration.

REFERENCES

KAUPP, B. F., *Anatomy of the Domestic Fowl,* W. B. Saunders Co.

BRADLEY, O. C., *The Structure of the Fowl,* Oliver & Boyd, London.

[1] *Anatomy of the Domestic Fowl.*

CHAPTER VIII

USING ARTIFICIAL ILLUMINATION ON LAYING AND BREEDING STOCK

Operations:

1. Installing illumination in the poultry buildings.
2. Operating the lights.

General information:

1. Artificial illumination vs. the hen's nature.
2. The principle of artificial illumination.
3. Intensity of light.
4. The lighting unit.
5. Means of supplying illumination.

1. Installing illumination in the poultry buildings

The lighting unit which best fulfills all the requirements is a standard 40-watt Mazda lamp. (If all-night lights are used, a 10- or 15-watt lamp may be used in place of each 40-watt lamp. The total watt-hours are not greatly different.) A cone-shaped reflector (Fig. 78), 16 inches in diameter at the base by 4 inches high, with the reflecting surface of aluminum bronze, gives the best results.

A. How to make the reflector. In Extension Bulletin 411, published by Cornell University, we find these instructions for making a reflector:

The local tinner can do a much neater job than the amateur. If the tinner is to make the reflectors, it will only be necessary to furnish him the shade holders and the dimensions of the reflector, 16 inches in diameter by 4 inches high, and to instruct him to rivet or solder the

shade holders to the reflectors. When the reflectors come from the tinner, wash them in a weak solution of vinegar and water, allow them to dry thoroughly, and then paint them on the inside with three coats of aluminum paint. One ounce of aluminum bronze and ¼ pint of French bronzing liquid will be sufficient for three coats on ten reflectors. The aluminum reflecting surface will not discolor, and will retain its reflecting properties much better than will white enamel paint.

B. Height above the floor. The best distribution of light is obtained when the lighting units with the reflectors are located 6 feet from the floor, 10 feet apart, and along a line midway between the front of the house and the front of the droppings board.

C. Determining the number of lighting units necessary per pen. In the Cornell Extension Bulletin 411 we find also these instructions for determining the necessary number of lighting units:

To find the number of lighting units that will be required for a given size of pen, divide the number of square feet of floor area by 200. The nearest whole number will be the number of units required.

EXAMPLES

(1) For a 15 by 50 foot pen:

$15 \times 50 = 750$ sq. ft.

$750 \div 200 = 3.75$

Thus, four lighting units will be required. Place these units 10 feet from either end and 10 feet apart.

(2) For a 20 by 20 foot pen:

$20 \times 20 = 400$ sq. ft.

$400 \div 200 = 2.$

Thus, two lighting units will be required. Place these units 10 feet apart and 5 feet from either end.

It has been found, by repeated experiments, that a spacing greater than 10 feet causes the birds to form groups under each unit. A 10-foot spacing of the lighting units produces a regular feeding area when floor feeding is practiced. A 12-foot spacing produces an irregular feeding area.

If the poultry house is partitioned into pens, figure each pen separately.

2. Operating the lights

The lights should be operated in accordance with the principles laid down in the following paragraphs.

A. Length of day. A 10-hour night and a 14-hour day provide a desirable lighting plan, duplicating the normal April night and day in the latitude of New York State. However, all-night lights, using a smaller lamp (page 156), are satisfactory.

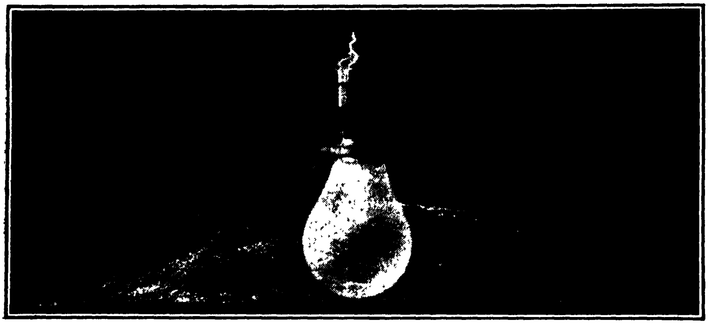

FIG. 78. The lamp and reflector. From Cornell Univ. Bul. 411.

B. General rules. The following rules for the use of artificial illumination on a flock of layers will be found useful.

Part-time lighting. (1) Turn the lights on, by hand or automatically, at 5 or 6 A.M.

(2) Turn the lights off after daylight arrives.

(3) Turn the lights on at twilight.

(4) Turn the lights off at approximately 6 or 7 P.M. When the above procedure is used it should be followed regularly throughout the season of illumination.

The exact time of day that the lights should be turned on in the late afternoon (3 above) will vary from day to day according to the season and condition and amount of sunshine.

It is desirable, but not absolutely necessary, to install a dimming device in order to enable the birds to go to roost of their own accord. However, if the birds are fed at 4:30 or

5:30 P.M., thus having $1\frac{1}{2}$ hours of feeding time before the lights are turned off at 6 or 7 P.M., they soon become accustomed to going to the roosts when their crops are filled.

For a few nights, the attendant should see that the birds which have not gone on the roosts of their own accord are

FIG. 79. Lighting units, with proper reflectors placed 10′ apart, provide correct conditions.

placed on the perches and are not allowed to remain on the floor or roost on the window sills, or interior fixtures. This precaution will usually result in fixing the roosting habit. It may help prevent colds among the birds and will prevent the appliances from becoming soiled.

All-night lighting. Turn the lights on any time in the evening and off when convenient in the morning. An automatic device will save current in the spring when daylight begins early.

C. Determining the season to start lights. The time of the year to start artificial illumination will depend upon: first, the latitude in which the poultry plant is located; and second, the age, the maturity, the laying and physical conditions of the birds. There is no one best time for all flocks.

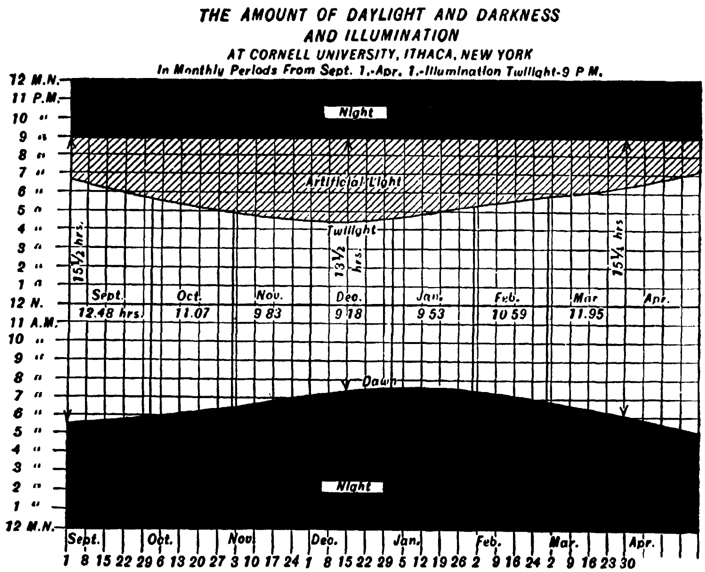

FIG. 80. **Lights to a certain hour at night only provide an uneven length of day.** Note the distance from dawn until the evening hour when the lights are turned off. A different length of day from day to day is not satisfactory.

D. Starting lights. When commencing to use lights in the fall of the year, full lighting may be given immediately. Once started, lights should be continued without interruption; otherwise a slump in production and a molt may occur.

E. Taking the lights off in the spring. Artificial illumination should be continued with commercial laying and breeding flocks until such time as the normal length of day is 13 to 14 hours. This usually occurs in the latter part of March or early

April. At this time the lights may be gradually discontinued until sunshine or daylight takes the place of artificial light.

All-night lights. Half the lamps in each pen may be discontinued first, and the others a month or six weeks later or just before the longest days of the year. All-night lights

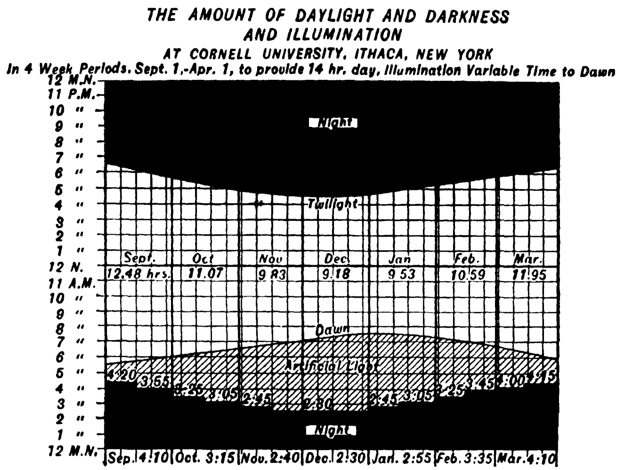

FIG. 81. Lights may be used in the morning only, but to secure an even length of day they must be turned on correspondingly earlier or later as the day shortens or lengthens. This is confusing and may result in an irregular length of day.

may be continued the year around thus relieving the operator of attempting to determine when stimulation from light is most needed.

F. Determining the time of day to use lights. The time of day when lights should be used will depend largely upon the source of light, i.e., commercial electric current supplied by power plants, current generated by a private or independent electric lighting unit, or lanterns. Whether the lights are given at twilight, later in the evening with an evening lunch, in the morning, both evening and morning, or all night is of less consequence than the total number of watt-hours of illumination.

The use of lights at any particular time of the day is primarily a question of convenience for the operator. Each method of using lights has its particular advantage.

(1) The *early evening* lights are easy to apply in many cases, since it enables the operator to include the feeding and lighting among the early evening chores.

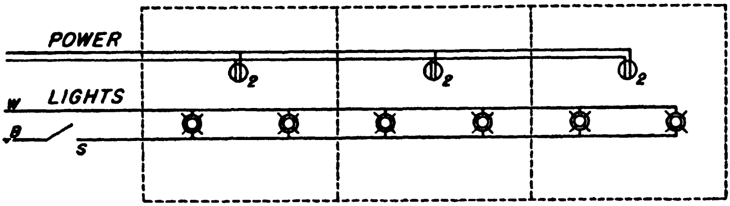

FIG. 82. Wiring diagram for morning light. This system of wiring is controlled by a switch and is the same as any house lighting circuit.

(2) The *morning* lights cause the birds to leave the perches quickly, thus exposing larger portions of the body to the rays of light. Morning lights may be turned on by an automatic device. Dimmers are unnecessary (Fig. 82).

(3) Giving the light *partly at night and partly in the morning* has the great advantage of enabling the operator to overcome the changing period of twilight and dawn, thus giving the birds a uniform day and a uniform night throughout the entire lighting season (Fig. 83).

(4) The *all-night* method comes closest to meeting individual needs. Hens go to roost about the normal time whether lights are on or not. A few may busy themselves about the pen the first half of the night. Starting at 1:00 or 1:30 A.M. larger numbers leave the perches. Thus, no bird is compelled to remain roosting longer than she desires.

G. Using lights on pullets. Separate the pullets into flocks according to their maturity and laying condition, as indicated by their comb development and weight.

(1) *High producers.* Well-matured pullets will be the best laying birds, assuming that all are approximately of the same

age and have been given similar rearing conditions. Such birds will require less light in order to give a satisfactory winter production. The better the laying quality of a bird, the less it needs artificial light to enable it to lay well.

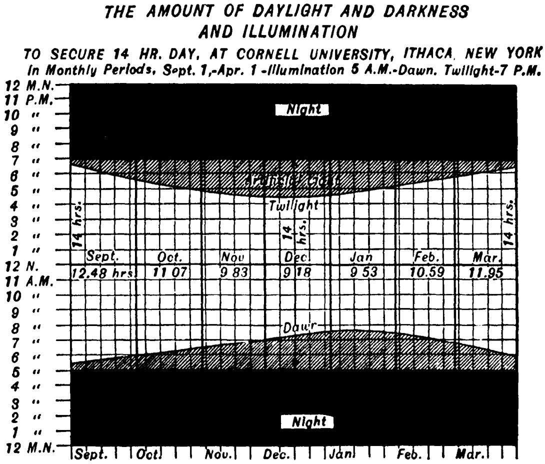

FIG. 83. Lights in the morning from a certain regular hour until daylight and from twilight until a certain fixed hour provide an even length of day during the winter and prevent a constant changing of hours for eating and sleeping, for the birds. There should be perfect regularity of the time between supper and breakfast and breakfast and supper throughout the winter.

Such pullets should continue to increase in production without lights until they reach the peak of production. Lights may be started just before or soon after production starts to decline. If very cold weather arrives first and the birds appear inactive, lights may be started. After once starting the lights, continue them until the following spring.

(2) The *slow-maturing pullets* of the same age as (1) should not be given illumination until they have well-developed bodies and have nearly reached sexual maturity. (See pages 13 and 14.) These two groups or grades of pullets (1 and 2) may be

combined at sexual maturity and given the same amount of artificial illumination.

(3) *Late-hatched pullets.* To late-hatched pullets which have not yet reached their proper size and maturity, little if any illumination should be given until their bodies are well developed, in order to prevent premature production of eggs and ultimate smaller size of eggs and stock.

(4) *Rule for using lights on pullets.* The principle which should be followed is that pullets must have an ample supply of a complete ration to meet adequately the demands made on the body by the stimulating effect of light, thus constantly maintaining or increasing the body weight.

H. Continuing fall production by the use of lights. The usual flock of hens during late summer and fall is made up of individuals which may differ widely in their physical condition and laying capacity. Artificial illumination cannot be applied with the greatest satisfaction to such a flock. Hence it follows that, if lights are to be used most effectively, the hens must first be separated into grades according to their physical condition and laying capacity. Failure to do this is the principal cause of the unsatisfactory results which sometimes follow the use of artificial illumination.

The first step, therefore, to be taken in the use of lights is to separate the prospective layers into flocks during the fall and winter so that all the hens in each flock may be given their best opportunity to perform.

(1) *Cull.* The hens that *cease production during June, July, and early August* presumably are such poor layers that it would not be profitable to feed them during their long vacation period in order to get the few eggs they might lay in the fall and winter. These birds should be culled (Chapter I).

(Early-hatched birds that have laid continuously for 13 or 14 months by June or July and then have rested may be kept for a second year. As layers, however, they are less desirable than their sisters in 3 and 4.)

(2) *Start lights.* As the days become shorter in late August and September in the latitude of New York State, lights, unless *all-night lights* are used the year around, may be started on the laying flocks, keeping a 13- to 14-hour day. This practice holds the birds in production longer in the fall, at a time when egg prices are usually advancing.

(3) *Desirable performers.* The birds that cease production, under normally satisfactory conditions of feeding and care, in late August or September, may be culled or, if they are to be held as layers for a second year, they should be given full opportunity to recover their plumage and regain their weight. To do this, place them by themselves in separate pens but without artificial illumination. Recovery is indicated by the return of a normal amount of color pigment in the beak, shanks, plumage, and skin. Give artificial illumination 4 to 6 weeks after production ceases, at which time their new plumage will be growing well. They should respond quickly with a production of approximately 50 per cent or more, and should maintain it with only slight variation, under correct methods of feeding, through the winter. They may drop off slightly for a short time in the spring of the year and increase production during the late summer.

(4) The *fall-lighted flocks* (2) will contain birds that continue producing well into the winter. However, if the birds are to be held for production a second year, better results, financially, are likely if they are given ample time to rest, recuperate fully, regain their weight, and renew their plumage and pigmentation.

About October 1 to 15, force the remaining non-molting birds out of production.[1]

I. Forcing birds out of production. Turn off the lights abruptly. Take the mash away. Give no water for one day. As soon as production has stopped and the birds are molting, feed grain and mash in the usual manner. Four to 6 weeks

[1] These dates are often advanced (see page 375, Controlling egg production, for suggestions concerning breeders).

from the time production ceased, give artificial illumination in the usual manner. The new plumage should then be well started.

From the above it will be seen that artificial illumination provides a powerful controlling factor in starting or in stopping production, as may be desired according to the quality of the birds.

J. Artificial illumination in the second year of production. Artificial illumination, it should be understood, with all of its power in controlling production, cannot create a condition which will enable birds to lay uninterruptedly from one laying cycle into the next without a rest.

Two methods of managing birds through the winter are used: first, the *forced rest* described on page 165; second, *continuous lighting.* In the latter method management for production continues through the winter and the following year. Individual birds will cease production for a time, rest, molt, and resume production.

Continuous lighting appears best when birds are not to be held as second-year producers but are culled as they cease to lay during the fall, winter, or spring.

K. The problem with high producers. The more highly birds are developed by breeding in their tendencies to lay large numbers of eggs, the more difficult becomes the problem of creating conditions which will enable these high-producing birds to take their vacations before they have reduced their vitality to the point of permanent injury.

A mistake which is made too often is allowing the high-producing birds to continue in production until a short time before the hatching season or even, in some cases, to continue right through the season without a stop. The desire of the owner for eggs at that time of the year must not take precedence over the natural laws of reproduction which demand that breeders be allowed a rest of several weeks or months in order that good fertility, hatchability, and vigor of chicks may be secured.

Breeders, therefore, should be thrown out of production ap-

proximately 15 to 16 weeks before chicks are desired. (See pages 375 and 376.)

Birds handled as suggested under H to J are more vigorous, more productive, and produce more fertile eggs and stronger chicks than hens not having this advantage.

L. Using lights on males. Whatever tends to cause the development of eggs in the female results in more active mating and fertilization of eggs on the part of the male. Males may give better fertility when placed under lights about 3 weeks before the breeding season.

M. Cost. One extra egg per bird during the fall or early winter is usually sufficient to cover the cost of the electric current. Poultrymen have frequently found that the increased returns due to artificial illumination have been sufficient to cover the entire cost of installation and operation the first year where 1000 birds or more were involved.

The fuel and operating cost of lights for a flock of 1100 birds were 4.4 cents per bird for the season where an individual Farm Lighting Unit was used, according to the N. J. Agricultural Experiment Station. In this case one egg per bird would about pay the bill.

The Oregon State Agricultural College found that "the cost of electricity was always small in comparison with the increased returns for winter eggs. Less than two-fifths of an egg per hen, per month, paid the electricity cost." This station found, on the basis of a flock of 400 pullets not culled during the period, that for 11 months the gain made by the lighted pens over the unlighted would pay 8 per cent interest on an investment of $1013 in lighting equipment. Had the test been made on a properly culled flock, the value of lighting would, no doubt, have been even more pronounced.

GENERAL INFORMATION

1. Artificial illumination vs. the hen's nature

The hen is by nature a native of a tropical country where the nights and the days are of essentially equal length, and

where the temperature permits fowls to live in the open air the year round. In domestication in the North, she is kept under unnatural conditions.

In all the centuries during which the hen has been under domestication, she has adapted herself to her environment—to cold climates, unnatural food, and close confinement—by changing her habits, rather than by changing her physical nature. Not being able to migrate to more favorable environments as some of her bird relatives do, when the days shorten and the amount of light lessens, she simply makes the best of it. She produces fewer eggs unless her progressive owner gives her the normal daylight conditions of spring during the dark winter months.

The owner can accomplish essentially the same result either by transferring the hens in the fall of the year to a more congenial southern climate where the hours of daylight are longer and the nights are shorter, as in Florida, or by doing what is less expensive and more practicable—by providing light to duplicate the normal spring day in the North or winter day in the South.

The hens can then see to eat and work as they desire. Food and water, while not the primary motivating influences, are efficient co-workers with artificial illumination. If they are not supplied in quantity, the stimulating effect of light may result disastrously, by causing loss in weight and production.

2. The principle of artificial illumination

Light increases food consumption indirectly. Certain rays of light stimulate, largely through the eye, the hypophysis or pituitary gland near the base of the skull. This gland, under this stimulation, liberates into the blood circulation a material called a *hormone* (one of several), which in turn stimulates the ovaries of the bird, causing increasing development of the egg yolks.

The rapid growth of egg yolks draws heavily on the reserve

food supply and the consumption of food is increased as larger numbers of eggs are produced.

Birds bred for many years for high production are less affected by light, possibly because the availability and supply of the particular hormone are likewise hereditary.

But the proper use of artificial illumination is a wonderful aid, even under these conditions. Its use to help prevent slumps in production during very cold weather and to start birds into production quickly after the rest period are examples.

However, the most marked results are seen on late-maturing pullets and on hens which, under normal conditions, would not have laid until spring. Here the difference in production due to the use of artificial illumination is sometimes surprising.

Whetham [1] states that "high producers are less affected by variations in the daily light period, probably because of an hereditary high level of the hormone" involved, and further that light raises "the production of the poorer . . . toward that of the best," presumably by stimulating an increased secretion of the necessary hormone until the amount more nearly approaches the amount already available to the higher producers.

3. Intensity of light

The use of artificial illumination is closely associated with the method of feeding. Although the effect of light is one of stimulation, an appetite for more food is created. The birds should go to roost with full crops. Hence, the influence of the method of lighting on the efficiency with which the birds can eat grain at night must be considered.

A greater intensity of light is needed when feeding grain in the litter at night, in order for the birds to see the kernels of grain, than is required when feeding by the trough or free-choice methods.

Professors Fairbanks and Heuser, in the Cornell Extension Bulletin 411, have written on the intensity of light, the lighting

[1] Whetham, E. O., *Poultry Science*, page 399, November, 1933.

unit, and the means of supplying illumination. Their comments and suggestions are reproduced in the remaining pages of this chapter.

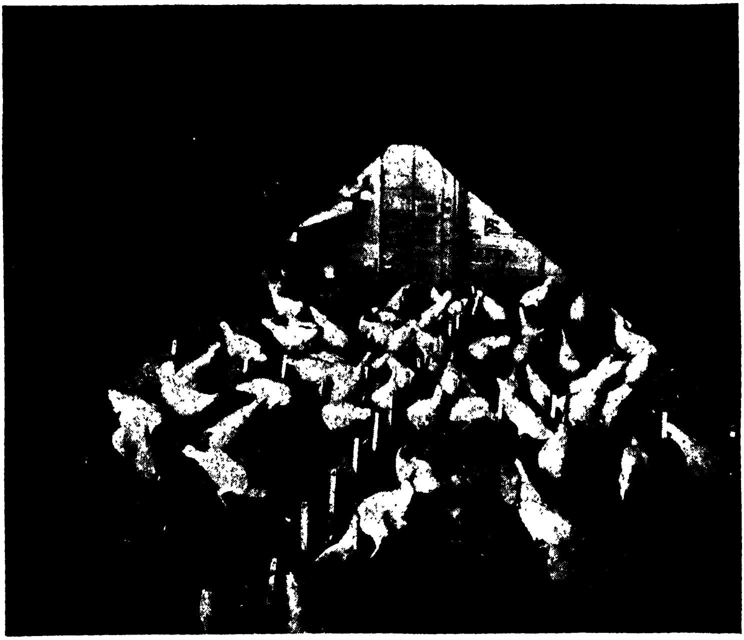

FIG. 84. Result of using a wrong type of reflector. The corners and perches are dark.

Since nature determines the rapidity with which birds pick up grain under normal daylight conditions, it seems reasonable to assume that there is a certain intensity of light on the floor of the poultry house below which a decrease in the activity of the birds would be noted and above which no increase in activity would be obtained.

The general illumination of the pen is quite as important as is the illumination of the floor. In experiments at Cornell University, it was found that, even with the proper intensity of light on the feeding floor, if the perches were dark, a number of the birds would not come down to feed (Fig. 84); and that when the lighting unit was changed so as to throw light on the perches and at the same time keep the proper floor intensity, all the birds came down to feed (Fig. 79).

It has been determined that the intensity of light on the floor necessary for active feeding is from 0.8 to 1.0 foot-candle.[1]

4. The lighting unit

The selection of the lighting unit therefore resolves itself into a question of the size of the lamp, the size and shape of the reflector,

FIG. 85. A light without reflector results in a dimly lighted pen.

and the height from the floor which would best combine to give the required intensity of light for active feeding, over the largest floor area and also on the perches, with the least expenditure of electric energy.

A. The lamp. Refer to Fig. 78.

B. The reflector. Refer to Fig. 78.

The effect on the birds of a lamp without a reflector is shown in Fig. 85. There is not enough light on the floor for the birds to see the

[1] A foot-candle is the amount of illumination given by a standard candle at a distance of one foot.

grain readily. Owing to the insufficient light, the birds are not active, and are going back on the perches.

The cause of this low intensity on the floor is that the rays of light are going out from the lamp in all directions, some striking the walls and the ceiling, where light is not needed. When the reflector, a very important part of the lighting unit, is placed on this lamp (Fig. 79),

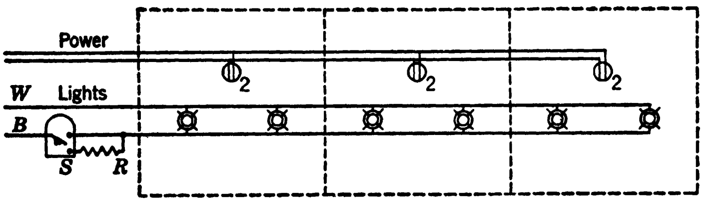

FIG. 86. The resistance unit system.

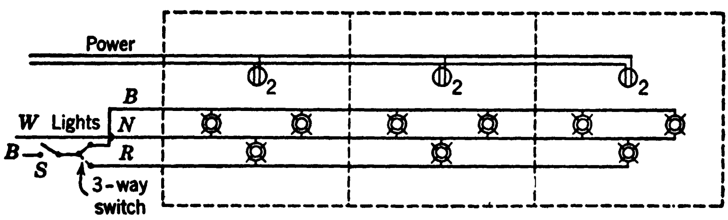

FIG. 87. The two-circuit system.

it will deflect the rays of light from the walls and ceiling to the floor. When the reflected rays are thus added to the direct rays from the lamp, they bring the light on the floor to the proper intensity for active feeding.

5. Means of supplying illumination

The easiest and most efficient method is by the use of electricity.[1]

These subjects are discussed thoroughly in Cornell Extension Bulletin 204 and a book in the Wiley Farm Series *Electricity in the Home*

[1] When it becomes necessary to carry electric current from a distance to and into the poultryhouse, special information is needed concerning the size of wiring necessary to carry the maximum amount of current required, the system of wiring best adapted to the particular situation, and proper installation.

and on the Farm, by Forrest B. Wright. The various power companies have valuable publications, free upon request. A good contractor or other capable electrician is necessary in order that the work will meet the approval of the National Board of Fire Underwriters.

A. Two systems of wiring for dimming lights. See Fig. 82 for wiring diagram for morning light.

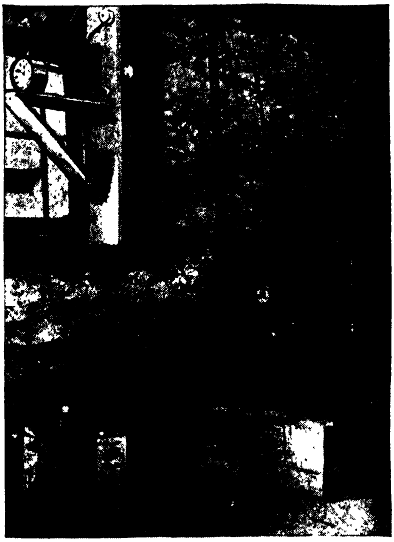

FIG. 88. A farm lighting plant. Note the automatic switching device in upper left corner. See Fig. 89.

(1) *The resistance-unit system.* The resistance-unit system now used (Fig. 86) makes use of a fixed resistance R instead of a variable resistance. The time switch S turns the lights on bright by moving the knife arm up to contact the main circuit. To dim the lights, the knife arm is moved down to throw the resistance R in series with the lights. To turn the lights off, the knife arm swings up to the central, or off, position as shown in Fig. 86. This system does not lend itself readily to any subsequent rearrangement, because, if the number of lights were increased or decreased, the resistance unit also would have to be changed, in order to give the desired intensity of light. This system is seldom used.

(2) *The two-circuit system.* The two-circuit system consists of two lighting circuits (Fig. 87) with a common wire or two separate circuits of two wires each. For this system, three wires are run the length of the house. Across N and B are the standard 40-watt lamps for the bright

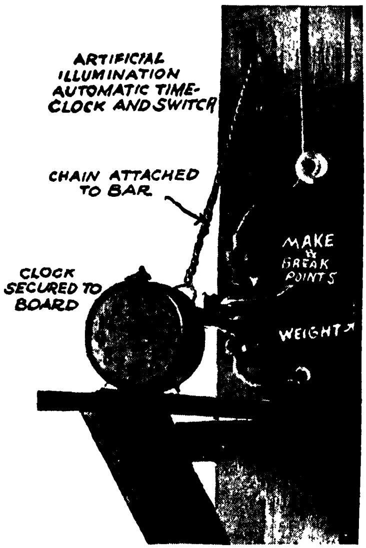

FIG. 89. Alarm clock device for turning on lights shown in Fig. 88. A nail in the end of the switch handle is caught under the key of the alarm. As the alarm goes off, the key turns and the weight pulls the arm up and makes the connection, thus switching on lights.

light, and across N and R are the small 10-watt lamps for the dim light, one for every 400 square feet of floor area. To turn the bright lights on, the switch arm is moved up to contact the BN circuit. When the dim lights are required, the switch arm is moved down to contact the RN circuit. A standard three-way switch can be used for this purpose. A single pole switch should be installed in the live wire ahead of the three-way switch, as shown in the drawing, to provide a means of turning off all lights.

This system may be operated by hand or by a time clock, and it permits any method of handling birds under artificial light.

B. Control devices. About control devices Professors Fairbanks and Heuser have written:

The simplest circuit is one without a dimming device and requires only a switch for turning the lights on and off. The time switches that are on the market for this purpose cost from $10 to $15; but many ingenious poultrymen have connected an ordinary alarm clock (Figs. 88, 89, and 91), with a simple switch for turning on the lights.

FIG. 90. Dim light arrangement for the two-circuit system. A 10-watt bulb is used within the 6″ porch globe. The half of the globe toward the perches is painted black. The 40-watt bulbs in the other sockets are the type shown in Fig. 78. Cornell Ext. Bul. 90.

C. Gasoline and kerosene lanterns. On this subject Professor Fairbanks wrote in a previous Cornell Extension Bulletin, No. 90:

Where electric current is not available and the size of the poultry plant does not warrant the purchase of an independent lighting system, several other sources of light may be used successfully.

The use of kerosene lanterns serves the purpose of lighting up a small portion of the feeding area of the floor so that the fowls may secure food from the feed hopper and in the litter near the lantern. Considering the cost of fuel, the time spent in operating the lantern, and the possible danger from fire, the kerosene lantern, when lighted outside of the poultry building and placed properly in it, is perhaps our simplest form of illumination.

FIG. 91. Device for turning lights on. Alarm clock and tumbler switch. Cornell Ext. Bul. 90.

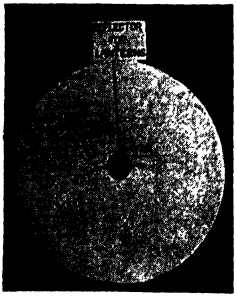

FIG. 92. Large reflector used with gasoline lanterns.

Side or top reflectors may be used advantageously to concentrate the light where it is most needed (Fig. 92).

The gasoline lantern furnishes a more brilliant light than does the ordinary kerosene lantern. During the time it operates, it has the disadvantage, unless a special reflector is used, of throwing a dark shadow directly beneath the bowl of the lantern. Gasoline, being more volatile and explosive than kerosene, is somewhat more dangerous from the standpoint of fire hazard. The intensity of the light of the gasoline lantern, when proper pressure is maintained in the tank, is its chief advantage over the ordinary kerosene lantern as a source of illumination.

Gasoline or kerosene lanterns or open-flame lights of any kind should be used, if at all, only when the attendant is reasonably near and can use the lights in connection with his regular chore work, thus reducing the danger of fire.

COMMUNITY SURVEY

Visit as many poultrymen as possible and, by means of inquiring and by observation, find:

(*a*) The methods of supplying light, such as lanterns, home generating plant, city supply, etc.
(*b*) What percentage of the poultry keepers are using lights.
(*c*) What kinds of reflectors for electric lights are used.
(*d*) During what hours lights are used.
(*e*) The number of lights carried.
(*f*) The watts or candle-power used per hour of illumination.
(*g*) The total watts or candle-power used per day.
(*h*) The methods of wiring for electric lights.
(*i*) How far above the floor the different lights are located.
(*j*) What, in the minds of the poultrymen of the community, are the chief benefits derived from lights.
(*k*) What the cost of lights is for the year.
(*l*) What percentage of the poultry keepers are using lights on breeders.

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CHAPTER IX

KEEPING RECORDS OF THE FLOCK

Practices intended to improve the poultry enterprise may be put into effect quickly, because the business lends itself readily to study by means of records and accounts. Rapid advances in the poultry business have been brought about in recent years by the experiment stations and colleges of agriculture and by the accurate records and accounts kept by poultrymen. Because of the varying conditions existing on poultry farms, it is necessary for the poultryman to keep such records as will enable him to study his business. Records and accounts, accurately kept and studied, will bring increased profits in greater proportion than almost any other work the poultryman performs.

Operations:

1. Keeping the egg record.
2. Keeping the flock record.
3. Keeping the incubation record.
4. Keeping the brooder record.
5. Keeping the financial records.

1. Keeping the egg record

Regardless of the number of records kept, no poultry enterprise, whatever its size, should be without a record of the daily egg production.

A. Using the sheet. A sheet may be placed in each house, or in the room where each day's gathering of eggs is counted. Tack a string and pencil, with eraser, to the wall near the sheet.

EGG RECORD CORNELL POULTRY ACCOUNT BOOK **PEN SHEET**

NEW YORK STATE COLLEGE OF AGRICULTURE AT CORNELL UNIVERSITY, ITHACA, N. Y.

Operator No. 63 Period

Total eggs during year 34945 Breed S. C. W. L. Pen No. 1 and 2 No. Birds 212

Days	October		November		December		January*		February		March	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
1......	72	25	125	16	98	36	85	38	54	21	35	16
2......	77	17	132	26	82	38	96	35	35	27	32	21
3......	85	22	124	34	78	41	87	46	39	20	39	10
4......	100	8	125	42	78	30	77	39	39	7	26	15
5......	86	31	111	39	98	22	90	44	37	12	41	20
6......	87	19	114	53	80	26	88	42	46	12	24	13
29......												
30......	81	65	75	42	80	43	45	24	....	....	....	73
31......	100	44	....	....	99	23	48	15	....	....	65	18
Total...	3275	1098	3270	1090	2567	903	2196	1060	1117	516	1302	459

* A respiratory disease broke out in January. Apparently this was a form of wet pox, unaccompanied by external lesions. Production dropped. Many birds molted. Production was resumed after two months.

B. Importance. The egg record shows variation in production, and gives information on which a change in feeding or management may be based. It serves to check the influence of weather conditions, feeding, housing, and general care on production, and is used as a basis for flock improvement. It also creates and stimulates interest in better management.

2. Keeping the flock record

This record *does not* include males, except that the number on hand at the last of each month may be recorded, if desired.

A. Using the sheet. Record any change that occurs in the number of birds.

B. Importance.[1] This record shows the number of birds in the flock at any time. It shows when mortality occurred, gives a record of culling, and, with the egg record, provides a means of finding the per cent production during any month or any period of time.

3. Keeping the incubation record

A. Using the record. A record should be kept of eggs set, chicks hatched, pen number, percentage infertile or dead or both, and other details of each hatch. A card may be tacked at each machine, or at each section in the case of Mammoth machines. By numbering trays, a record may be kept of any group of eggs on which the data are desired.

Some persons prefer to use one large sheet only, recording on it the data as found. This may save time for the operator and is best under some conditions.

B. Importance. The incubation record not only gives a check on the fertility and hatchability of the flock for different periods during the season and for different seasons, but enables the operator to compare the efficiency of different pens, or perhaps different individuals in the pen, if pedigree breeding work

[1] The method of figuring per cent production is shown in Chapter X.

is being done. (See Chapter XIX for discussion of pedigree breeding.)

Perhaps the greatest immediate service rendered by the incubation record is of an experimental nature, and consists of checking the efficiency of machines or sections in the same machine, or the method of operating machines. This record is made more interesting and profitable when used in connection with a sheet on which the temperature curve is plotted as the hatch progresses and changes in ventilation and moisture conditions are recorded.

4. Keeping the brooder record

A record should always be kept of the number of chicks placed under a hover, the date hatched, the mortality each day, and birds sold or used. On this sheet or elsewhere the amount and value of feed, litter, and fuel used should be recorded.

A. Using the sheet. If the chicks are brooded in large flocks, a sheet for each flock is desirable. If a hatch is divided among several small hovers, one record for the entire hatch may be sufficient.

B. Importance. The brooder record shows the mortality and the number of chicks on hand at any time, and compares the efficiency of groups of chicks, heaters, and brooder practices.

5. Keeping the financial records

On most farms, poultry is kept for financial gain. The best results can usually be accomplished, and the facts of the business most clearly known, when a system of accounts is kept.

Poultry keeping is a business involving many financial and other details. No business can be efficiently managed without keeping adequate records.

A. Single entry. The single-entry system of bookkeeping is best for the small flock. By its use a record is kept of all income and outgo. From it a person can find the gain or loss,

CORNELL POULTRY ACCOUNT BOOK

MORTALITY AND CULLING RECORD **PEN SHEET**

Operator No. 63 Period ....

Number to begin period: Hens .... Pullets 212 Breed W. L. Pen No. 1 and 2

Days	October		November		December		January		February		March	
	Died	Culled	Died	Culled	Died	Culled	Died	Culled	Died	Culled	Died	Culled
1												
2					1							
3												
4												
5												
6												
30												
31												
Total												
Hens added												
Date	Nov. 1		Dec. 1		Jan. 1		Feb. 1		Mar. 1		Apr. 1	
Hens left	211		208		203		198		195		194	

BROODER RECORD

RECORD LOSSES BELOW

Name No. 63 Breed W. L.

Chicks Placed in Houses			Month	Mar.	Apr.	May	June	July	Aug.	Sept.
Date		No.	1							
		489 W. L.	2							
		27 Red Rock	Cross 3	males. Black						
			4					1 Bl. used		
			5							
To range		W. L. Pullets	6							
June 1		225	7				1 Ckl.			
2		36	8							
Capons		20	9							
			10							
			11							
Total			12		1 Bl.					
Ckls. Sold or Eaten			13		4*					
Date		No.	14							
May 25		51	15			1 Ckl.				
June 4		80	16							
June 11		74	17							
May 30		used 4	18		1		2 Pullets, 8 Ckls. used			
June 18		used 8	19							
			20			1 Ckl.	1 Bl. sold			
Total W. L. Ckls.		217	21			1 Bl. used	1			
Pullets Sold			22							
Date		No.	23		1 Bl.					
			24							
			25							
			26							
Total			27						1 Bl. used	
Pullets in Laying Houses			28							
Pen	Date	No.	29				1 Bl. used			
1	A. and S.	117	30		1	4 Ckls. used				8 missing
2	Sept.	95	31							
3	Sept.	40	Total							

* Oil stoppage in brooder stove, 70° at noon. Temp. back to normal by 2 P.M.

INVENTORY *

Farm No. 63

Include below everything used for or by the poultry flock, either the whole valuation or the proportionate share.	Beginning of year			End of year			Change	
	Number or amount	Value each	Total value	Number or amount	Value each	Total value	Increase +	Decrease −
		Dollars	*Dollars*		*Dollars*	*Dollars*	*Dollars*	*Dollars*
I. STOCK †								
Pullets	252	1.00	252.00					
Hens	29	1.00	29.00	129	.70	90.30		
Males—Capons	14		21.00					
Broilers and fryers	6		4.80					
Total stock								
II. FEED								
Grain	50		1.15	200		4.30		
Mash	75		1.75	100		2.30		
Grit, shells	150		1.50	50		.50		
Total feed								
III. LITTER								
IV. EGGS ON HAND								
V. EQUIPMENT AND SUPPLIES								
Specs	250		5.00					
Water warmers						7.50		
Watering equipment	3		9.00	3		8.28		
Egg cases, fillers, cartons, etc.								
Shipping coops	3		3.00	3		2.76		
Fencing								
Disinfectant and spray material	½ gal.		1.44					
Cleaning equipment			1.00			1.00		
Feed and egg pails	6		1.00			1.00		
Feed hoppers			20.00			18.40		
Superphosphate			1.00			.50		
Hatchet and nails			1.00			.75		
Miscellaneous								
Total equipment								
VI. LAND								
VII. BUILDINGS								
Laying houses and barn			234.50			210.00		
Brooder houses								
Storage space, feed, eggs, incubators, litter								
Total buildings								
Total investment			588.14			347.59		240.55

* This inventory is for a laying flock only. Rearing inventories are not included. See pages 201 and 202 for example of finding rearing costs.

† Inventory stock at the price they normally would have sold for on the farm.

the amount of grain and mash consumed and cost of the same, the number of eggs sold, consumed at home, or used for incubation, the causes of gain or loss, and other information of interest and value.

(1) *The inventory.* This is essential in any type of accounts. An inventory may be taken of the entire enterprise, of the laying or breeding flock, or the rearing, depending upon the study to be made. The proper expense and income items should accompany any particular inventory. An inventory consists of a list of all the things one owns and of all the debts one owes. A value is assigned to each article.

The best time to take an inventory is when there will be the least figuring involved and at the logical time for closing the year's business. For a poultry enterprise, this is usually September 1 or October 1.

Taking the inventory. Make a list, in a book, of the items suggested on page 184. Leave space between for other items, if found. Take a pencil and the list, and go over the plant systematically. Enter the number of each item found and estimate its value. The basis for estimating values should be the value which would probably be received for the article at the farm, if there were plenty of time in which to make a sale.

At the end of the account year, use the same list and make the rounds of the plant as before, adding to or subtracting from the list as the case may be.

Taking an inventory after the first year requires only a short time.

The depreciation charge. (*a*) Items may be entered in the last inventory at a certain percentage less than in the beginning inventory; *or* (*b*) items may be entered at their value in both inventories, the percentages applied to the average of the inventory items, and the result entered as an expense (debit). Common depreciation percentages are, 3 on buildings, 10 on portable colony houses, range shelters, and fences, and 8 on other equipment.

EXPENSES FOR

Expenses and income should be recorded each day. If there are no whether there were no items to be recorded or whether they were forgotten. Include here eggs used for home consumption (not including hatching eggs) worth at the farm at that time.

Date	Grain			Mash			Other feed			Litter			Egg cases, fillers, cartons, and the like	
	Pounds	*Dollars*		*Pounds*	*Dollars*		*Pounds*	*Dollars*		*Pounds*	*Dollars*		*Dollars*	
1.........	Wh 1000	eat 23	33											
2.........														
3.........														
4.........	C 100	orn 2	30	100	2	80								
5.........														
6.........														
28.........														
29.........														
30.........	C 100	orn 2	35											
31.........													55 c/s	
Total....	1600	37	28	300	8	40		1	65				6	60

* Include only hatching eggs purchased.
† Indicate kind and number of poultry in last column.

MONTH OF JAN.

expenses, place a check mark (√) by the date, so that you will know later
Each item of expense and income is to be listed under the proper heading.
and feed or other supplies used from the farm, valued at what they are

Disinfectants and spray material	Electricity	Chicks		Hatching eggs *		Poultry †	Other costs ‡	
Dollars	*Dollars*	*Number*	*Dollars*	*Dozen*	*Dollars*	*Dollars*	*Dollars*	*Explanation*
							80	Carting
							3 20	

‡ Do not include building repairs or long-time investments such as buildings or special equipment (brooders, incubators, and the like) which will last more than two years.

INCOME FOR MONTH

Date	Eggs sold *				Eggs consumed at home			POULTRY					
								Hens			Old males		
	Dozens	*Price*	*Dollars*		*Dozens*	*Dollars*		*Number*	*Dollars*		*Number*	*Dollars*	
1.......													
2.......													
3.......													
4.......	30 L. 12 L. 18 M.	.30½ .28½ .26	17	25									
5.......													
6.......													
28.......													
29.......													
30.......													
31.......													
Total..	266½		72	52									

* Indicate hatching eggs by *x*.

OF JAN.

SALES												Poultry consumed at home		Other Income		
Breeding cockerels			Pullets			Broilers			Chicks							
Number	*Dollars*		*Number*	*Dollars*		*Number*	*Dollars*		*Number*	*Dollars*		*Dollars*		*Dollars*		*Explanation*
												2	00			
												5	00	1	26	6 pullets used 42 bags returned

When repairs are made during the year, increase the value at the last inventory [under (*a*) above] after the depreciation has been figured; *or* [under (*b*)] the depreciation charge in the expenses may be decreased accordingly.[1]

Value of inventory. The inventory shows the amount of money invested in the enterprise. It serves to call attention to the condition of equipment and to repairs that should be made; it is also a reminder of tools which have been lent or borrowed and not returned.

(2) *The charge or debit.* A record must be kept of every purchase. The principal item will be feed, but there are a great many other items for which cash will be spent during the year. If a record is not made when these articles are purchased, they are likely to be forgotten. These items include disinfectant, litter used, fees for various purposes, taxes, insurance, egg cases, equipment purchased, and many other things.

(3) *The poultry credits.* The credits include all transactions in which anything of value is disposed of; they may include eggs or poultry sold, used, or given away, feathers sold, manure sold or used on the farm, equipment sold, etc.

The records may be filed away and worked up as time permits.

(4) *The summary.* Each month the totals of expenses (debits) may be transferred to a similar sheet with one line for each month. The amount and value of each item, as grain, mash, chicks, etc., can be compared easily any time. A quick summary of income vs. expenses thus far in the record year is

[1] The Cornell Poultry Account book suggests the following method of charging to cover *interest, taxes, repairs,* and *depreciation.* Average the values in both inventories, find a percentage of this average, and enter the result in the expenses (debits).

Buildings	10%
Land	7%
Equipment	15 to 20%
All other items	6%

then possible. The same procedure should be followed with the income (credits).

In order to have the information available for use in the next year's work, the yearly summary should be made promptly at the end of the year and the labor income on poultry, or the profit, determined.

B. Keeping a rearing account. For keeping a record with rearing only, the single-entry system may be used. The plan is the same as that just outlined. An inventory of items used during rearing, or a proportionate value of buildings, land, or equipment used, is needed.

A complete record of the debits and credits for the period, together with the inventories, provides the data from which one may figure the cost of producing pullets, amount and cost of feed, and many other items.

Points to have in mind. In a single-entry set of accounts, an entry should not be recorded if a payment is made on a mortgage or bill for anything that has been inventoried. When an item is inventoried it means that the enterprise is charged with that item at the start or credited with it at the end. When a payment on the article is made, the transaction is outside of these accounts and should not be entered.

An increase in inventory during the year should be reckoned as a receipt or credit, and a decrease in inventory should be reckoned as an expense or debit.

Check over the differences between the inventories, and see that the proper entries have been made in the debits and credits.

COMMUNITY SURVEY

1. Canvass the farms in the neighborhood and list the records that each is keeping with the different farm enterprises.
2. How many are keeping complete cost accounts on one or more enterprises?
3. How many are keeping a cash account only?
4. Are any of the poultrymen keeping a single-entry account such as that outlined in this chapter?

5. Secure the following facts from as many farms in the neighborhood as can be visited during the period of the class assignment. When all records have been secured, a class exercise should be planned for combining the information secured for the entire community.

Farm No. .... Name of operator ....
Date of taking record ...... Year record is taken ....
Size of farm .... Acres owned ...... Acres rented ......
Kind of animal enterprises kept commercially ....
(Arrange in order of importance)
What cash crops are grown? ....(arrange in order of importance)
Number of mature birds ....Breed ....
Number of pullets .... Cocks .... Cockerels ....
What per cent of the poultry is marketed alive? ...... Dressed? ......

Products sold	Amount	Value
Market eggs	....	....
Fowls	....	....
Broilers	....	....
Breeding stock	....	....
Day-old chicks	....	....

What per cent of the total farm income is derived from poultry?

REFERENCES

Poultry record books from your state college or agricultural school.

CHAPTER X

STUDYING THE RECORDS

In Chapter IX the various operations required to keep records on poultry were described. Merely to keep records and accounts is not sufficient, however. They must be analyzed carefully to see how the business may be improved the following year. At the end of the year it is important for the poultryman to ask and answer four questions:

1. How much is the business making for me?
2. How much have the various departments gained or lost?
3. Why did certain departments fail and others succeed?
4. Where has my money gone?

If a good income was received, it is important to know whence it was derived. A good income from eggs might be due to low cost of production, or to a high average price for a certain period or a particular year, or to all these causes.

Studying records is a good rainy-day job. Keeping and studying records does not *take* time; it *saves* time, by affording short cuts in actual practice.

In this chapter a method of summarizing the data from single-entry accounts will be described.

Operations:

1. Finding the percentage of production.
2. Finding the labor income on poultry.
3. Finding the profit on poultry.
4. Finding the cost of rearing pullets.
5. Finding the cost of producing eggs.

General information:

1. Explanation of cost items.
2. Factors affecting profits.

1. Finding the percentage of production

Both the *flock* and the *egg* records are used in finding the percentage of production.

A simple method is to take the number in the laying flock in the beginning inventory, add any additions during the month, subtract any death losses and those sold or consumed. The result is the number left on the last of the month. The average of the two figures times the days in the month gives the "hen days." The number of eggs produced divided by the hen days and multiplied by 100 equals the percentage of production.

Production per hen per year. Add the number in the beginning inventory to the twelve average monthly numbers and divide the sum by 13. This equals the average number of hens for the year. Divide the total eggs produced by the average number of hens to equal production per hen per year.

2. Finding the labor income on poultry

Labor income may be defined as the proceeds a person receives for his year's work, above all farm expenses and interest on the capital, in addition to having the use of his house and the farm produce for the family. It is what a person receives for his labor. All labor employed or used, except the operator's labor, is included in the farm expenses.

In finding the labor income, therefore, it is customary to include as real estate the value of the dwelling. The results in this chapter do not include the dwelling or a proportional share of it, as varying residential values would materially influence the results. In this respect the term "labor income" as here worked out differs from "labor income" in the large sense;

hence we speak of it as the "labor income on poultry." It deals with one department of a farm business, whether this department be a part or the whole of the business of the farm.

To find the labor income on poultry, three groups of figures are necessary: first, two complete inventories, one at the beginning and another at the end of the year; second, total expenses for the year; and third, total receipts.

Inventories from Farm No. 63 appear on page 184. Inventories are used to find the increase or decrease in inventory at the end of the year and to find the interest on the capital invested.

Referring to page 184, we find a decrease of inventory of $240.55.

The decrease is due to the loss in stock inventory and depreciation of equipment and buildings. Stock of the same quality should be inventoried at about the same amount each year. Stock which is held over to later inventories is usually valued less than on the previous inventory.

The following shows the method of arriving at the labor income:

Average capital (average inventories)		$467.87
Receipts:		
Eggs	$882.01	
Poultry	72.24	
Manure	15.00	
Miscellaneous	26.42	995.67
Expenses:		
Feed	$499.47	
Labor (except operator's)	....	
Miscellaneous	98.26	
Decrease in inventory	240.55	$838.28
Plant income		$157.39
Interest on average capital at 5½ per cent		25.73
Labor income on poultry		$131.66

SUMMARY OF EXPENSES

The expenses and receipts for Farm 63 were as follows,

Farm No. 63

Month	Grain		Mash		Other feed		Litter		Egg cases, fillers, cartons, and the like
	Pounds	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*	*Dollars*
Sept.	3,400	69 68	400	10 60			308	1 54	50 c/s 6 00
Oct.	400	9 30	700	18 60	100	1 00			
Nov.	1,500	30 11	400	10 90	100	70			
Dec.	600	13 50	500	13 80	100	70			
Jan.	1,600	37 28	300	8 40	CLO 1 gal. 100	95 70			55 c/s 6 60
Feb.	1,400	34 40	200	5 15					
Mar.	1,200	2[illegible] 20	300	7 90				60	
Apr.	1,300	34 15	500	13 65	100	80			
May	1,200	31 65	400	11 00					
June	1,000	2[illegible] 30	500	13 75	100	70			
July	800	20 20	400	10 00	100	70			
Aug.	1,000	22 65	500	12 05			100	50	
Total	15,400	357 42	5,100	135 80		6 25		2 60	12 60

FOR THE YEAR

after they were summarized from the single entry record:

Disinfectants and spray material	Electricity	Chicks		Hatching eggs		Poultry	Other costs	
Dollars	*Dollars*	*Number*	*Dollars*	*Dozen*	*Dollars*	*Dollars*	*Dollars*	*Explanation*
							11 94	
							4 80	
							6 62	
							12 10	
							3 20	
							2 00	
							2 40	
							3 60	
							4 40	
							4 60	
							11 00	
	6 00						10 40	
	6 00						77 06	

SUMMARY OF INCOME

Farm No. 63

Months	Eggs sold				Eggs consumed at home			POULTRY					
								Hens			Old males		
	Dozens	*Price*	*Dollars*		*Dozens*	*Dollars*		*Number*	*Dollars*		*Number*	*Dollars*	
Sept......	68½		19	09				12	6	30			
Oct......	329¾		103	28									
Nov......	450		160	97				13	6	91			
Dec......	295⅚		95	43				15	6	23			
Jan......	266½		72	52									
Feb......	180		42	70									
Mar......	180		46	73									
Apr......	270		67	19									
May......	330		79	94									
June......	270		67	43				16	11	20			
July......	240		68	50									
Aug......	180		58	23	275	68	75	55	41	60			
Total..	3059 7/12		882	01	275	68	75	111	72	24			

FOR THE YEAR

SALES								Poultry consumed at home	Other income	
Breeding cockerels		Pullets		Broilers		Chicks				
Number	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*	*Dollars*	*Dollars*	*Explanation*
								5 50		4 fowls 3 broilers
								6 70	1 18	3 broilers 3 capons bags (41)
								5 00		2 capons 2 fowls
								7 50		5 capons
								5 00	1 26	6 fowls bags (42)
								6 00		2 capons 3 fowls
								3 50	78	3 fowls 1 capon bags (26)
								8 00	30	8 fowls bags (10)
								6 00	75	6 fowls bags (25)
								3 50	90	2 fowls 1 capon bags (30)
								4 00	45	4 fowls bags (15)
								 3 00	20 14 15 00 66	miscellaneous 3 fowls manure value bags (22@ .03)
								63 70	41 42	

In addition, the following were used in the house:

Eggs, 275 doz.	$68.75
Meat, 41 fowls	39.00
14 capons	21.00
6 broilers	3.70

Plant income is what the poultry keeper receives for his time and the use of his money. Deducting the interest leaves the amount received for his time, or the labor income on poultry. In addition to this figure, he must consider that various products from the plant have been used in the house throughout the year. On a large enterprise labor income is usually larger than profit, while on a small business the reverse is likely to be true.

3. Finding the profit on poultry

Profit differs from labor income in that, in calculating profit the enterprise must receive credit for all products of the plant that have been used by the operator. The enterprise must also pay for all the operator's labor in addition to the other expenses. Profits may be defined as "the return from a business or enterprise or transaction above all costs. The return should include both actual receipts and actual or estimated appreciation on capital involved. The costs should include all actual expenditures and the estimated value of all labor, materials, etc., used; all rents, interest, insurance, and any depreciation on the capital involved." [1]

To find the Profit on Farm 63, it is necessary to add to the labor income the value of the products used and deduct the value of the operator's labor.

Labor income on poultry	$131.66
Value of product used	132.45
Total	$264.11
Value, operator's labor (estimated)	$50.00
Profit	$214.11

[1] From Department of Agricultural Economics, Cornell University.

4. Finding the cost of rearing pullets

In finding this cost, record and proceed as follows:

(1) Take two inventories, one at the beginning and one at the end of the year. The inventories should include everything used for rearing, but not the value of the chicks themselves.

(2) Record all costs of rearing, including hatching eggs secured from the breeding flock or chicks purchased.

(3) Record all returns of rearing, including cockerels sold, used, or retained. Pullets sold or retained are not considered.

(4) Deduct the returns from the costs. This figure represents the *working capital* which is required to rear the pullets

Cost of Rearing Pullets

Financial Record of Chickens Raised Name of Operator............

Farm No. 63 Address................

Inventory

Include below everything used for rearing, either the whole valuation or the proportionate share.	Beginning of period Date,			‡ End of period Date,		
	No. or amount	Price	Value	No. or amount	Price	Value
Items						
I. Real Estate						
Land..................	1a	......	$25.00	1a	....	$25.00
Brooder house...........	1	....	15.00	1	....	15.00
Range shelter...........	2	....	8.00	2	....	8.00
Barn *................	....	....	......	....	....	....
II. Equipment, Supplies						
Water founts...........	2	....	3.00	2	....	3.00
Brooder................	....	......	....	1	......	14.00
Pails..................	......	......	1.00	....	....	1.00
Feeders................	....	......	....	4	....	2.00
Miscellaneous...........	.....	......	5.00	......	.....	6.00
Total †..............			$57.00			$74.00

* Proportionate share used for storing feed, litter, supplies, equipment, etc.

† A difference in the totals means an " Increase " or " Decrease in Inventory " and will appear in " Returns " or " Costs," respectively.

‡ Any item appearing in the Inventory at the " Beginning of the Period," if still on hand at the " End of the Period," must not be valued higher at the " Second Inventory " than it was at the first, unless special improvement has been made. In this event it must appear as a " cost." Ordinary " repairs " to " equipment " or buildings should not add to the " Inventory value " of any item.

and none of which is returned to the operator until the pullets are placed in winter quarters.

(5) Charge interest on one-half of the working capital for 6 months at 6 per cent and add to the working capital. The result is the net cost of rearing.

(6) Divide by the number of pullets reared to find the cost per pullet.

Cost of Rearing Pullets

Farm 63 Cost

Include below everything used for rearing, either the whole or proportionate share	No. or Lb.	Value
I. Feed: Homegrown or purchased		
Grain..............	3090	$56.58
Mash..............	3450	79.00
Grit..............	.....	.33
II. Labor		
Man hours @ .25...	252	63.00
Use of auto.........	.....	2.00
III. Taxes............	.....	....
IV. Insurance..........	.....	....
V. Fees and dues	.....	....
VI. Water............	.....	....
VII. Interest on Av. Investment @ 5½%	.....	3.60
VIII. Misc. Expenses		
Chicks............	.....	72.00
Fuel..............	.....	6.65
Litter............	.....	.50
Hauling feed (outside labor)..........	.....	1.00
Disinfectant........	.....	.50
Equip. purchased...	.....	22.52
Repairs and depreciation..........	.....	1.99
IX. Decrease in Inventory (if any)....	.....	....
Total cost of rearing......		$309.67

Returns

Confine all returns strictly to rearing operations	No. or Lbs.	Value
I. Feed bags sold......	47	$1.41
II. Manure used.......	.....	5.00
III. Broilers sold,	205	49.80
used	19	6.98
IV. Roasters sold, used or retained........	20	25.80
V. Miscellaneous returns	.....	6.29
VI. Increase in inventory (if any)..........	.....	17.00
Total returns............		$112.28

Summary

Total cost of rearing......	$309.67
Total returns (except pullets)..................	112.28
Working capital..........	197.39
Interest on half working capital for 6 months....	2.71
Net cost of rearing pullets	200.10
Number pullets retained..	252
Cost per pullet...........	0.794

5. Finding the cost of producing eggs

On farms where the rearing expenses, receipts, and inventories are kept separate, the cost is readily found. The necessary steps are:

A. Inventories. At the beginning and end of the year, take inventories of the capital invested in real estate, stock, equipment, and supplies used for the laying and breeding flocks. Rearing inventories are not included.

B. Costs. These include the value of all materials of any nature purchased or received for the use of the adult flock and include feed, labor, taxes, insurance, fees, interest on the average inventory, decrease in inventory (if any), and any miscellaneous costs.

C. Returns. These include all sales from the adult flock except sales of eggs, the increase in inventory (if any), and any mature stock used by the operator's family or given away.

D. Cost of producing eggs. Deduct the returns from the cost and divide by the number of dozens of eggs produced, as shown by the daily egg record. See page 204 for method of finding costs.

GENERAL INFORMATION

1. Explanation of cost items

The following items of cost may require some explanation.

A. Labor. In finding costs, labor must be included as a cost. If a record of the exact hours and value has not been kept, an estimate of the time required and value should be made. On the average, about 2 hours per year of man labor is required for each hen kept, and about 1 hour for each pullet reared. By the use of these figures and a certain rate per hour, the value of labor can be arrived at approximately.

On a large farm where horse labor is largely used, about one-tenth the number of hours representing man labor will be required for horse labor, for cleaning, carting, etc. Since the horses are seldom used without equipment of some sort, usually

a harness and a wagon, the same number of hours of equipment labor is charged as for horse labor. If an automobile or truck or both are used, estimate the mileage and charge 3 to 6 cents for the automobile and 5 to 10 cents for the truck, depending on size and age.

COST OF PRODUCING EGGS

Cost

Include all items and values of items used by all old stock.	No. or Lb.	Value
I. Feed (Homegrown or purchased)		
Grain	15,400	$357.42
Mash	5,100	135.80
Other feed	....	6.25
II. Labor		
Man-hours 450.4 @ .25	....	112.60
Horse-hours, 5 @ .10	....	.50
Equip. hours, 5 @ .10	....	.50
Use of auto	....	7.80
III. Taxes	....	....
IV. Insurance	....	....
V. Fees and dues	....	....
VI. Water	....	....
VII. Misc. expenses		
Litter	....	2.60
Egg cases	....	12.60
Truck shipment charge	Eggs	41.20
	Poultry	6.75
Equipment purchased	....	7.50
Superphosphate	....	1.00
Electricity	....	6.00
Repairs	....	11.81
VIII. Interest on Av. Investment * at 5½%	....	25.73
IX. Decrease in Inventory (if any)	....	240.55
Total cost of eggs		$976.61

Returns

	No. or Lb.	Value
I. Feed bags sold	211	$6.28
II. Manure used est.	.....	15.00
III. Stock sold and used		
Fowls	152	111.24
Capons	14	21.00
Broilers	6	3.70
IV. Miscellaneous returns	.....	20.14
V. Increase in inventory (if any)	.....	....
Total returns		$177.36

SUMMARY

Total cost of eggs	$976.61
Total returns	177.36
Net cost of eggs	799.25
Total dozen produced	3334 7/12
Cost per dozen	0.24

* Inventory for the laying flock on Farm 63, page 184.

B. Taxes. No taxes were charged to the poultry on this farm. It is likely that a charge should have been made, but the figure was not given.

C. Poultry fees. Fees for associations, entry fees at fairs, etc., should be included.

D. Water. The water on Farm 63 is drawn from a spring. The upkeep is very small, and the operator felt that no charge was necessary.

E. Depreciation. See page 185.

F. Equipment or stock purchased. These items increase the last inventory. As any increase acts as a return and tends to lower the cost just that much, it follows that the items must be included in the costs to offset it.

G. Hatching eggs or chicks. The cost of eggs used for hatching or for chicks is part of the cost of rearing, and must be added as a cost, whether they are purchased or produced on the plant.

2. Factors affecting profits

Various factors may be found after summarizing a set of accounts, many of which may be of great importance in measuring efficiency in management and in showing where the weak or strong points are. Various factors from the records of Farm 63 may serve to illustrate.

A. Labor income and profits

Labor income on poultry	$131.66
Labor income per hen	0.585
Profit	214.11
Profit per hen	0.951
Eggs and poultry used by the family	132.45

The amount received for the operator's labor (labor income) is low. A smaller flock is likely to show a smaller labor income on poultry per bird than a larger flock, if the same value of eggs and poultry is used. In this case the value of products used exceeds the labor income figure. Since this is so, profit is higher.

Higher egg production would have increased both figures. High feed prices and low fall egg prices prevailed.

Under the circumstances the operator provided the family with eggs and poultry and made money in addition. A larger business should have shown increasingly higher returns since all products above family needs could then have been sold.

B. Investment

Average number of hens	225.2
Average investment	$467.87
Investment per hen	$ 2.08

The investment is unusually low. The building is many years old but serviceable. A new building of the same capacity would raise the inventory considerably. Hoppers, water stands, nests, and the like were built by the owner. Almost no new equipment has been purchased in recent years, and there is no unnecessary equipment. The birds are inventoried at a reasonable value at the start and at meat value at the end. The plant is efficiently capitalized. An effort has been made to keep the investment low and to get long-time use of equipment.

C. Eggs, production, and sales

Total egg production	3334 7/12 doz.
Production per hen	177.7
Market eggs sold	3059 7/12 doz.
Eggs used	275 doz.
Cost of producing eggs	$0.24
Cost of feed per doz. eggs	$0.15
Average price received per doz. market eggs	$0.288

These results show a narrow margin between the cost of production and the price at which eggs were sold. The price received was one to two cents above the top quotation on the New York market. The feed is 62.5 per cent of the total cost of producing eggs. Higher egg production per hen would reduce the cost of eggs. On the basis of the 281 hens at the

beginning of the year the production was 142.4 eggs or 177.7 eggs for the average number of hens. Without disease more eggs might have been laid.

D. Feed

Pounds of grain per hen	68.4:	Cost $1.59
Pounds of mash per hen	22.6:	Cost .60
Cost of grain and mash per hen		2.19
Per cent of mortality, based on the number of hens at the beginning of the year		5.7
Per cent culled, based on the number of hens at the beginning of the year		47.7

The ratio of grain to mash indicated that the flock was fed by the "free-choice" method (page 103). Ninety-one pounds of grain and mash were consumed, in spite of the reduced consumption during part of the winter when the flock suffered from chicken pox (page 235). The cost of food was average.

The mortality is lower than is usually experienced. A high food intake resulting, no doubt, in a fine physical condition together with careful culling may have helped keep mortality low.

Altogether these results are desirable.

Pounds of grain per pullet reared	12.3
Pounds of mash per pullet reared	13.7
Cost of grain and mash per pullet reared	$0.538

Considering that the food consumed by several capons is included, these figures are low. Mash was kept before the birds constantly during the brooding and rearing periods and grain, also, after the first 6 weeks.

A knowledge of the management conditions often helps when results are studied. These chicks were moved to a fine grass range when 8 weeks old. They were separated into two flocks, each in a range shelter. A brook furnished fresh water. Abundant green food during the growing season apparently helped to reduce the feed cost.

E. Brooding and rearing

WHITE LEGHORNS

Number chicks at start	489
Number dead and missing	18
Percentage dead and missing	3.7
Number cockerels sold and used	217
Percentage cockerels sold and used to chicks started	44.4
Number pullets housed	252
Percentage pullets housed to chicks started	51.5
Pullets used as broilers	2
Percentage used as broilers	0.4
Number chicks per pullet housed	1.94

RED ROCK CROSS

Number at the start	27
Number died	2
Percentage sold, used, or retained	92.6

These results are excellent. Reference to the brooding record (page 183) will show that 8 pullets were missing when they were moved from the rearing field to the laying house in the fall. Considering the 8 as dead, the mortality is 3.7 per cent. Good brooding and rearing and pullorum-free chicks are responsible, together with properly selected breeders.

The number of pullets exceeded the cockerels. This is chance and cannot be credited to skill in operation. It does contribute, however, to the high number of pullets housed in relation to the chicks started.

The chick mortality is being duplicated on many farms and should be on others. Science has contributed greatly to the success of poultrymen in this field.

COMMUNITY SURVEY

1. Using forms similar to those in this chapter, secure figures from one or more farms in the community and find:
   (*a*) The labor income on poultry.
   (*b*) The profit on poultry.

(*c*) The cost of producing one dozen eggs.
(*d*) The cost of rearing a pullet.

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CHAPTER XI

DIAGNOSING COMMON DISEASES

PARASITES, PESTS, AND VICES IN ADULT STOCK

Operations:

1. Examining a live bird.
2. Examining a dead bird.

Vastly discouraging, and in the aggregate totaling an enormous loss, is the mortality which frequently occurs in both mature and young stock. This loss is a serious drain upon the profits of keeping poultry. Much can be done to reduce it.

To have a well reared flock of mature birds, in good health and producing well, is a source of keen satisfaction.

To find a dead bird occasionally and not know the cause of death is, to many careless poultrymen, nothing more than the "expected normal mortality" of a flock and often does not create a proper feeling of concern.

To discover many dead birds, together with a diseased appearance of the flock as a whole and a pronounced drop in egg production, and *then* not to know the cause or the means of correcting it, is a pitiful condition, in fact, a calamity to the poultry keeper.

Considerable time and care are required to bring the flock back into production after the cause of the trouble has been found and removed or corrected. This loss in production emphasizes the need of great vigilance on the part of every poultry keeper.

Every person keeping poultry will do well to attempt to

diagnose the cause of every death that occurs. Many diseases and troubles can be recognized at once by anyone who has given some thought and study to the subject. Other troubles are revealed only by a careful post-mortem examination of the inside of the bird's body, while still others require laboratory facilities for studying bacteriologically and otherwise.

This chapter and the one following have been arranged to aid the poultry keeper in diagnosing the various troubles, and in determining the treatment, if known, that may be necessary for individuals or flocks, in order to keep the loss due to diseases and parasites as low as possible.

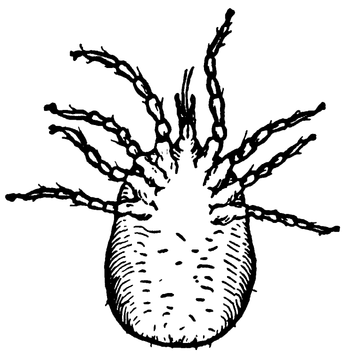


FIG. 93. The red mite. Drawn from specimen under the microscope. (Greatly enlarged.)

The reader should keep the following points in mind:

(1) Many diseases and parasites develop because of wrong conditions of sanitation, feeding, or other care. Where these conditions are correct, the percentage of mortality is likely to be smaller. Epizootic diseases occasionally cause great losses, but often the responsibility may be traced back to the operator.

(2) Unless a bird is particularly valuable or the disease especially responsive to treatment, it is better to kill a sick bird and bury it immediately rather than bother with individual treatment. A bird is of comparatively small value, so that if but a few individuals are affected it usually costs too much in time to attempt a cure.

(3) Certain diseases and troubles may be common in one locality but entirely unknown in another, primarily because of differences in climatic conditions.

(4) The following common diseases and parasites should be familiar to every poultry keeper:

DISEASES, PARASITES, AND TROUBLES WHICH FREQUENTLY CAN BE DETERMINED WITHOUT OPENING THE BIRD [1]

Apoplexy	Fowl tick	Pickout
Blue comb	Gapeworms	Prolapse of oviduct
Body lice	Inflammation of crop	Red mites
Canker	Iritis	Scaly leg
Chicken pox	Limberneck	Sticktight flea
Colds	Mechanical canker	Tropical or Northern mite
Coryza	Newcastle disease	Vent gleet
Cropbound	Paralysis, fowl	
Enlarged crop	(avian leucosis complex)	

DISEASES AND PARASITES, SOME OF WHICH CAN BE DETERMINED WITHOUT OPENING THE BIRD, BUT WHICH NEED A POST-MORTEM EXAMINATION

Air sac mites	Internal hemorrhage
Aspergillosis	Internal layer
Caecal worms	Roundworms
Cholera	Ruptured yolk
Chronic coccidiosis	Tapeworms
Diarrhea	Tuberculosis
Dropsy	Tumors
Impaction of the oviduct	Lymphomatosis, visceral (big liver)
Infectious laryngotracheitis	(avian leucosis complex)
Infectious bronchitis	

1. Examining a live bird

When a bird appears to be out of condition, one of the first things to do is to examine the perches and see if red mites are present (Fig. 93). (For combating and treating the diseases and parasites mentioned in this chapter, see Chapter XII.)

Next pick up the bird and, if uncertain as to the nature of the trouble, examine the different parts of the body systematically, referring to the following (see Fig. 9):

[1] See Chapter XXIII for discussion of mortality of young stock and other diseases affecting them.

HEAD

There are several symptoms to look for on the head. These will be discussed in order.

Comb. (*a*) Symptoms: Purple blade. Frequently found but usually not serious. May indicate slow circulation at that point.

(*b*) Symptoms: Bluish comb and wattles. Slight limpness of comb. Sometimes accompanied by shrinking of the legs, diarrhea, and sour smelling crop contents.

Disease—**Blue comb** or
Pullet disease, page 231.

Comb, wattles, base of beak or face. Symptoms: Small raised water blisters, when the disease is just starting or new spots are forming (Fig. 94). As these blisters get older they turn hard and dark (Fig. 95). Either type of blisters may occur alone, or both may be found together on the same individual.

Disease—**Fowl pox,** or chicken pox, page 235.

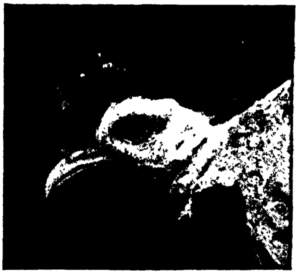


FIG. 94. First evidence of chicken pox. Note the blister.

Eyes and nostrils. (*a*) Symptoms: Watery eyes. Running or clogged nostrils, and stained shoulder feathers caused by rubbing the eyes. The odor is disagreeable. (See Fig. 96.)

Disease—**Colds,** page 240.

(*b*) Symptoms: Eyes filled with a yellow cheesy material.

Disease—**Mechanical canker,** page 246.
Advanced stage of colds, Fig. 97.

FIG. 95. An advanced case of chicken pox. Note the presence of scabs over the face, comb, and eyelids. Courtesy Dr. E. L. Brunett.

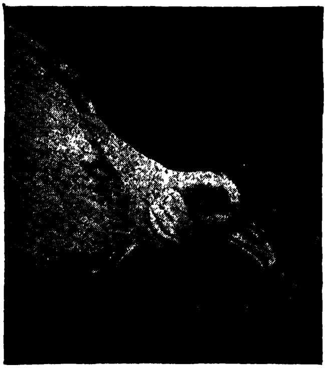


FIG. 96. A cold. Note watery eye and nostril, and slight swelling between the eye and beak.

FIG. 97. Advanced stage of cold. Note closed eye, bulging face, and stained feathers.

(*c*) Symptoms: Eyes filled with a whitish cheesy material.

Disease—**Vitamin A deficiency,** page 130.

In the more advanced stages, the eye may be displaced and closed by badly swollen membranes in the face. This condition may be accompanied by cheesy accumulations in the nostrils and bulging face (Fig. 97). In severe cases the bird is unable to close its beak.

Mouth. (*a*) Symptoms: The bird may gasp, and breathe with difficulty and more rapidly than usual. Breathing may be accompanied by a rattling sound or a wheezing in the throat. Coughing may be frequent.

Disease—**Aspergillosis,** page 231.
Infectious laryngotracheitis, page 243.
Infectious coryza, page 240.
Fowl cholera, page 237.
Infectious bronchitis, page 243.
Newcastle disease, page 246.

(*b*) Symptoms: Same as (*a*). Open the beak and look inside. Patches of yellowish-white, cheesy growth may be found on the membranes of the sides or roof of the mouth or on the throat. Occasionally, a white growth will be seen around the opening of the windpipe.

Disease—**Canker,** page 235.
Fowl pox, page 235.

Face near the eyes or comb. Symptoms: Ulcers or patches of small, dark brown insects.

Parasite—**Sticktight flea,** page 262.

If no symptoms have been discovered in the various sections of the head, pass to the other parts of the body, in order.

NECK

Symptoms: Head hanging with neck limp or twisted.

Disease—**Limberneck,** page 245.
Paralysis, fowl, page 247.

CROP

(*a*) Symptoms: Enlarged, hanging, bulging, and hard.

Disease—**Cropbound,** page 241.

(*b*) Symptoms: Enlarged, pendulous, and soft.

Disease—**Inflammation of the crop,** page 249.
Enlarged crop, page 242.

LEGS AND WINGS

(*a*) Symptoms: Weakness or entire loss of strength in one or more. Bird may look sick about the head or may be in excellent condition at first, but loses flesh in a few days and may die.

Disease—**Paralysis, fowl,** page 247, Fig. 98.

BODY

(*a*) Symptoms: Thin, emaciated. Sometimes coupled with swollen joints, causing lameness. When this condition is found, follow with a post-mortem examination.

Disease—**Tuberculosis,** page 250.

(*b*) Symptoms: Thin, emaciated; head and comb pale.

Parasite—**Internal parasites,** pages 257 and 262.
Chronic coccidiosis, page 239.

(*c*) Symptoms: Presence of egg-shaped, bluish-red ticks on thighs, breast, or sides.

Parasite—**Fowl tick,** page 252.

(*d*) Symptoms: Presence of small black specks on the feathers about the hocks or tail.

Parasite—**Tropical or Northern mite,** page 264.

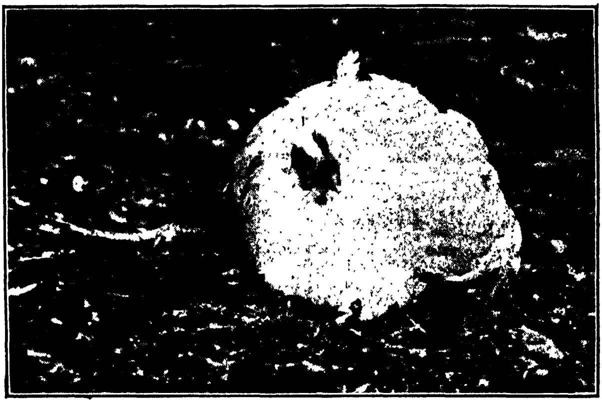


FIG. 98. A bird suffering from paralysis.

ABDOMEN

(*a*) Symptoms: Hard, sometimes enlarged. This should not be confused with a very fat abdomen (Fig. 100*A*). A fat abdomen, although hard just beneath the skin, will usually yield to pressure, showing that it does not fill the body cavity. If a lump is felt which is more or less loose in the abdomen, or if, in pressing with the fingers, a hard body is felt, as if a baseball were inside, the trouble may be either of the following:

Disease—**Tumor,** page 250.
Internal layer, page 245.

(*b*) Symptoms: Enlarged and soft. On working with the fingers, a substance like a sac of water is felt.

Disease—**Dropsy,** page 242.

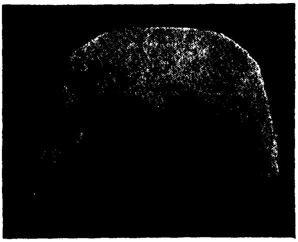


Fig. 99. Limberneck. Limp and helpless though alive.

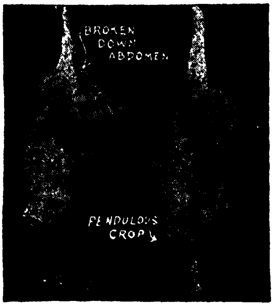


Fig. 100. *A*. Fat, broken-down abdomen. *B*. Pendulous crop.

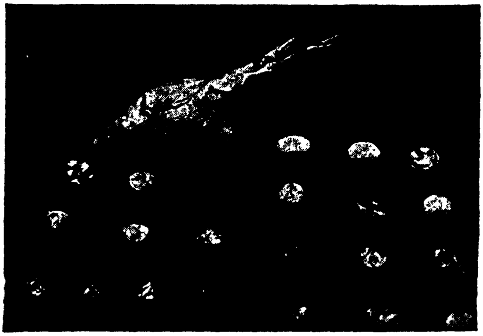


Fig. 101. Bird died, apparently owing to congestion in the abdomen. When examined, body cavity was found to be filled with these yolks and eggs.

VENT

(*a*) Symptoms: Skin around the vent inflamed. In a more advanced stage, there may be bloody sores covered with dark scabs. A disagreeable odor is given off.

Disease—**Vent gleet,** page 250.

(*b*) Symptoms: A mass of soft, inflamed material protruding from the vent or soiled plumage below vent.

Prolapse of the oviduct, page 249.

(*c*) Symptoms: Vent eaten away in part or entirely. Sometimes part of the back near the tail, or the abdomen, intestines and part of the gizzard eaten.

Vice—**Cannibalism,** page 233.

SKIN BENEATH THE VENT

(*a*) Symptoms: The presence of straw-colored, elongated insects. Very often patches or clumps of grayish material will be found attached to the bases of feathers at this section. These clumps are eggs of the lice, infesting the bird's body.

Parasite—**Lice,** page 252. (See Fig. 102.)

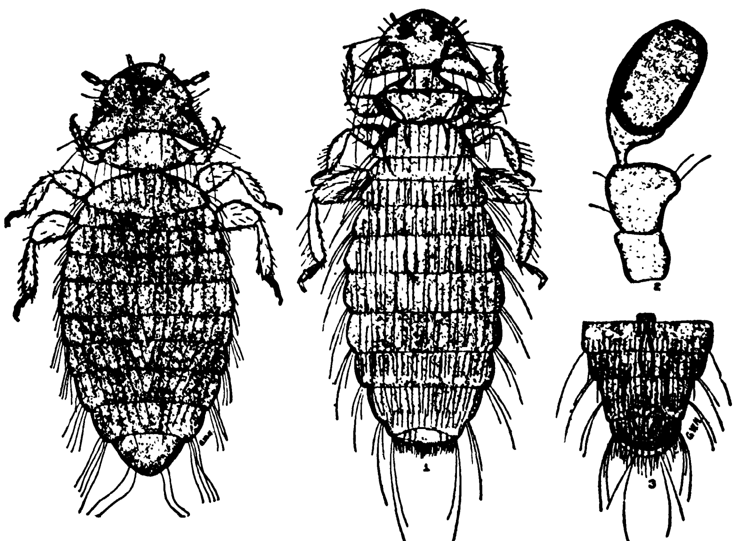


FIG. 102. Drawing (enlarged) of lice. *Left,* the common hen louse, male. *Right,* the common large louse of the hen. 1, Female; 2, antenna; 3, end of abdomen of male. Cornell Univ. Bul. 359.

(*b*) Symptoms: Feathers below the vent wet and soiled with litter or dirt, or having accumulations of greenish, yellowish, or watery discharges. Flaky white material around the vent.

Diarrhea, page 242.

FIG. 103. A case of scaly leg.

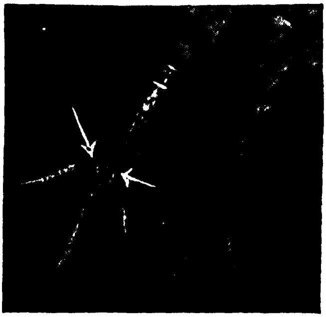


FIG. 104. Bumble foot. Note the swelling between the toes of the foot on the left.

SHANKS

Symptoms: Rough, raised scales with white, powdery material beneath. This condition is known as scaly leg (Fig. 103).

Parasite—**Scaly leg mite,** page 258.

FEET

Symptoms: Bottoms of feet swollen. In a more advanced stage, the swelling may be inflamed, pushing out between the toes and causing lameness. (See Figs. 104 and 105.)

Bumble foot, page 232.

2. Examining a dead bird

(See Chapter VII for anatomy of the domestic fowl.)

When a bird dies, examine her comb and head first. If they are dark purple in color the trouble is likely to be

Apoplexy, page 231.

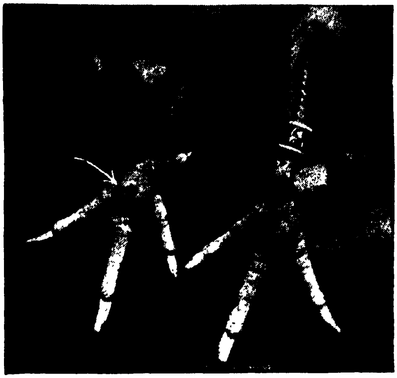


FIG. 105. Bumble foot. Note the hard, circular scab in the bottom of the left foot. Both feet are swollen, hot, and painful.

Symptoms: Birds in good physical condition, showing no evidence of disease or vermin, found dead on the nest or about the buildings during very warm weather.

Heat prostration, page 264.
Internal hemorrhage, page 245.

If neither of these troubles appears to be the cause of death, examine the bird externally for disease and troubles mentioned above.

In case the trouble cannot be diagnosed by a superficial examination or the bird has been killed because of a supposed disease, a post-mortem examination of the internal organs should be made to determine the cause.

A. Materials needed. A few materials, together with a knowledge of what to do and what to look for, are all that is needed.

The materials needed are:

A wooden surface about 2 feet square, such as a board or the side of a box, about waist high.

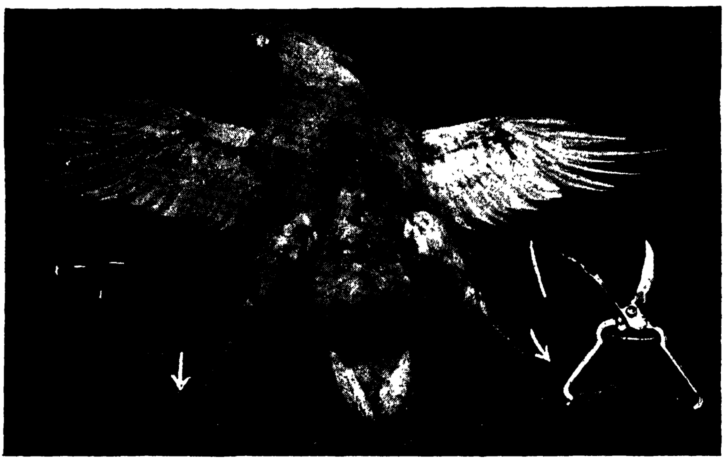


FIG. 106. Arranging the bird for post-mortem.

4 small nails.

A hammer.

A sharp knife.

A pair of heavy shears for cutting through bones (pruning or tin shears or any shears having a narrow blade on one side, for pushing between the bones and internal organs).

B. Arranging the bird. (Fig. 106.) Place the bird on its back, head away from the operator. Stretch the wings out, and nail to the board by passing a nail through each wing near the tip. Cut the skin between the legs and body, bend the legs back, dislocating the joints at the hips. Stretch the legs toward the operator and out, and nail through the web of the toes.

C. Opening the carcass. (Figs. 107, 108, and 109.) With the shears lay open the esophagus from the corner of the mouth to the crop. Look for cankerous growths inside the mouth and around the windpipe.

Slit the windpipe or trachea and the bronchi.

TRACHEA, LARYNX, OR BRONCHI

(*a*) Symptoms: Presence of bloody mucus.

Disease—**Infectious laryngotracheitis,** page 243.

(*b*) Symptoms: Moldy patches of a white or greenish yellow color, on the inside of the trachea. They may occasionally be found in the lungs and air sacs.

Disease—**Aspergillosis,** page 231.

ESOPHAGUS

(*a*) Symptoms: Numerous small whitish nodules on the inside lining.

Disease—**Vitamin A deficiency,** page 130.

With the knife, cut through the skin, across the abdomen. Grasping the skin near the vent, tear it loose from the breast by pulling up and toward the head.

Examine the breast, which should now be exposed. If it is found emaciated, tuberculosis, worms or leucosis may be the cause.

If small, hard, yellow bodies are found attached to the under side of the skin over the muscle, they are due to encysted parasites. These parasites have no harmful effect on the fowl and do not affect the edibility of the flesh.

D. Continuing the examination. Using the knife, cut through the flesh of the abdomen. Do not cut deeply.

With the shears, cut through the ribs to the neck near the base of the wing. Fold the breast back and remove.

(1) Symptoms: Clotted or fluid blood among the intestines and particularly in the region of the heart. Likely to be accompanied by a comb from which the blood appears to have been drawn.

Internal hemorrhage, page 245.

(*b*) Symptoms: Fine, yellow, dust-like particles. If found, examine between the ribs and internal organs, without displacing them, for the same particles. They may be found on the lungs or along the side of the body, where they are left after the rupture of the air sacs.

Parasite—**Air-sac mites,** page 251.

LIVER AND SPLEEN

(*a*) Symptoms: Presence of raised, white, hard, cheesy nodules, easily removed from the tissue with a pair of tweezers.

Disease—**Tuberculosis,** page 250.

(*b*) Symptoms: White areas, usually softer than the tuberculosis nodules. Removed with difficulty from the surrounding tissue.

Disease—**Tumors,** page 250.

Fold the liver back or remove in order that the heart may be seen.

HEART

(*a*) Symptoms: Clot of blood near the heart.

Internal hemorrhage, page 245.

(*b*) Symptoms: Sac (pericardial) about the heart enlarged and filled with a chocolate-colored pus. Pericardium may be attached to the heart by strings of tissue.

Disease—**Pullorum disease.**[1]

[1] Pullorum disease discussed in Chapter XXII, page 480.

FIG. 107. Skin removed from the breast and abdomen.

FIG. 108. The breast removed, exposing the internal organs.

With the fingers, loosen the heart, liver, and intestines and spread out over the board. They may be left attached to the bird at the beak and vent.

FIG. 109. Intestines removed and reproductive system exposed.

INTESTINE

(*a*) Symptoms: Nodules of various sizes attached to the intestinal wall. Occasionally several nodules and walls seem to be grown together. Cut a nodule. Open cavities are usually found which open into the intestine.

Disease—**Tuberculosis,** page 250.

(*b*) Symptoms: Clumps in the intestine. Whether found or not, cut the intestine lengthwise at intervals and examine for elongated, white worms. (See Fig. 110.)

Parasites—**Roundworms,** page 257.

(*c*) Symptoms: Segmented white worms attached at the small end to the intestinal wall. Length: 1 to 3 inches; sometimes 6 to 10 inches.

Parasite—**Tapeworm,** page 262.

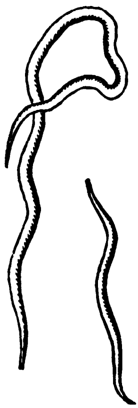


FIG. 110. The roundworm (enlarged).

FIG. 111. Pullorum disease or bacillary white diarrhea. Infected ovary. From Univ. of Conn.

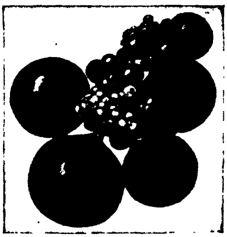


FIG. 112. Normal ovary. From Univ. of Conn.

(*d*) Symptoms: Thickened wall in the fore part of the small intestine. May be inflamed. Microscopic examination necessary for accurate diagnosis.

Parasite—**Tapeworm (microscopic),** page 262.
Chronic coccidiosis, page 239.

CAECA

Symptoms: Small worms ½ to ¾ inch long.

Parasites—**Caecal worms,** page 251.

OVARIES

Symptoms: Hardened, irregular bodies, mingled with the normal ovules. The color may be mottled, light, dark, or occasionally so dark and of such a color as to appear like gangrene. (See Fig. 111.)

Disease—**Pullorum disease,**[1] page 480.

Symptoms: Yolk material loose in and around the ovary.

Ruptured yolk, page 249.

OVIDUCT

Symptoms: Enlarged throughout several inches of its length. Upon opening, a mass of coagulated white material (albumen) is found.

Disease—**Impaction of the oviduct,** page 243.

ABDOMEN

(*a*) Symptoms: Free water in the body cavity.[2]

Disease—**Dropsy,** page 242.

(*b*) Symptoms: Hardened bodies, which when cut show a solid mass of yellowish material.

Internal layer, page 245.

(*c*) Symptoms: Complete or partly complete eggs outside of the oviduct and free in the body cavity. (Fig. 101.)

Internal layer, page 245.

[1] Pullorum disease discussed in Chapter XXII, page 480.

[2] That part of the body which contains the intestines and internal organs.

VICES

Symptoms: Evidences of broken eggs found in the nests; the beaks and heads of birds smeared with egg yolk.

Egg eating, page 264.

Symptoms: Birds bloody and partly eaten about the head or back.

During periods of heavy production, birds may be found dead, with vents, intestines, and, sometimes, their internal organs eaten away.

Cannibalism, page 233.

COMMUNITY SURVEY

1. What diseases appear to be most common among local poultry flocks?
2. What is the apparent cause?
3. How was the trouble checked?
4. Arrange with a local poultryman to examine all birds that die during one or more months. Determine the cause of death by a post-mortem examination on as many as possible, keeping account of the number that die from each cause.
5. What is the percentage of mortality in the flock for the period examined?
6. In what way, if any, might this percentage be decreased?

CHAPTER XII

TREATING DISEASES AND COMBATING PARASITES, PESTS, AND VICES

When one has determined the trouble, the next step is to know its cause and decide how to combat it. Many diseases are the result of wrong conditions. Individual treatment is expensive, seldom advisable, and of little lasting benefit unless wrong conditions are corrected. It is better to spend time and money in working at the cause, thereby reducing to a minimum the necessity of treating diseases. Any individual treatment to eliminate internal parasites of poultry must be considered as an expensive temporary expedient. The only satisfactory solution to the problem is prevention by methods of rearing and management.

General information:

1. Cause and treatment of various diseases.
2. Controlling disease by the carrier elimination method.

1. Cause and treatment of various diseases

Apoplexy
Aspergillosis
Blue comb
Bumble foot
Cannibalism
Canker
Chicken pox
Cholera
Chronic coccidiosis
Colds
Coryza, infectious
Cropbound
Diarrhea
Dropsy
Enlarged crop
Impaction of oviduct
Infectious bronchitis
Infectious laryngotracheitis
Internal hemorrhage
Internal layer
Limberneck
Lymphomatosis (big liver)
Mechanical canker
Newcastle disease

Paralysis, fowl	Fowl tick
Pickout	Lice
Prolapse of oviduct	Red mites
Ruptured yolk	Roundworms
Sour crop	Scaly leg mite
Tuberculosis	Sticktight flea
Tumors	Tapeworms
Vent gleet	Tropical or Northern mite
Air-sac mites	Heat prostration
Caecal worm	Egg eating

Apoplexy

Cause: A ruptured bloodvessel, which allows a clot of blood to press on the brain. Any unusual exertion, such as the strain of laying, or sudden fright, may cause apoplexy.

This is not a disease that will spread from bird to bird.

Treatment: Practically none for the individual, as the bird is usually dead when first observed.

Aspergillosis

Cause: Certain molds and their spores that occur on moldy, musty, and spoiled litter or feed. These molds work into the air passages and grow, penetrating the tissues and causing inflammation of these passages, later resulting in death.

Treatment: Consists mainly in providing only clean, wholesome feed and litter. Musty or moldy litter or feed should be avoided. Litter which has been wet and allowed to mold should not be used. Clean dry houses will do much to prevent these molds from starting.

Remove affected birds, bury any that die, and correct the conditions.

Blue comb

Cause: Unknown. More commonly affects pullets but may attack hens or males. More likely to occur in late summer or early fall in the North about the time pullets are increasing in production and during warm, humid weather. It is considered one of the most common and serious troubles. Heavy

mortality is frequent. Birds cease eating but drink readily.

Treatment: Potassium has a protective action on the kidneys. These organs are dangerously affected. Potassium may be fed as muriate of potash or molasses.

Muriate of potash—1 tablespoonful per gallon of drinking water for 4 days. For the next 10 to 14 days, mix 1½ pounds to 100 pounds of mash.

Molasses—1 pint per gallon of drinking water for several days followed by a wet mash 3 to 4 times daily of:

50 parts ground oats
50 parts wheat bran
10 parts molasses
5 parts water

Bumble foot

Cause: Bumble foot is probably due to a bruise which develops pus beneath the skin. Small stones in the runs or gravelly floors of a poultry house, high perches, requiring the birds to jump to hard floors, and, more commonly, a lack of litter on the floors may be causes.

Bumble foot is an abscess or corn which forms on the bottom of the foot and may spread between the toes.

This trouble does not spread from one individual to another.

Treatment: Somewhere, usually on the bottom of the foot, a round, hardened scab and core, about ⅛ inch or larger will be seen. Pull this out with the fingernails or with tweezers (Fig. 113). A long core is usually attached to the scab and comes out of the opening, thus leaving a hole. Disinfect the wound thoroughly with 1 to 1000 bichloride of mercury solution or any other good disinfectant. Then apply iodine and fill the hole with Carbolated Vaseline.

If the swelling spreads out between the toes, make an incision at the top and clean out all pus before disinfecting.

The bird may be released with the flock in mild cases; or the foot may be bandaged and the bird placed by itself for 2 or 3 days in advanced cases.

Cannibalism

Classed under this heading are various kinds of picking, as toe, feather, back or sides, and cloaca or vent. Toe and feather picking often occur among *chicks* at 3 to 5 weeks of age if they are *overcrowded, have too little feeding space,* or are kept under *too high temperature.* Chicks will often pick the new quills and later follow along these quills with their beaks to take off the blood.

Picking is most common with *adults* during the first laying year.

"Pickouts" may result from prolapse cases but not necessarily so. It often occurs when, immediately after laying, the oviduct protudes slightly for a short time. Floor layers are often victims.

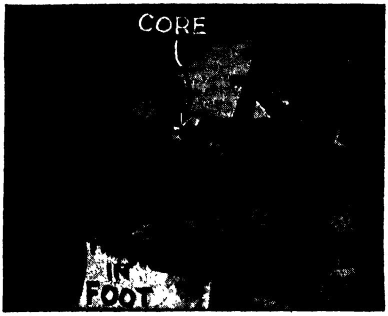
Control: (*a*) *Chicks*—Put pine tar or an "anti-pick" on the injured part.

(*b*) *Adults—Salt* in the drinking water, 1 tablespoonful to a gallon when any picking is noticed. Continue for 3 days, repeating later as needed.

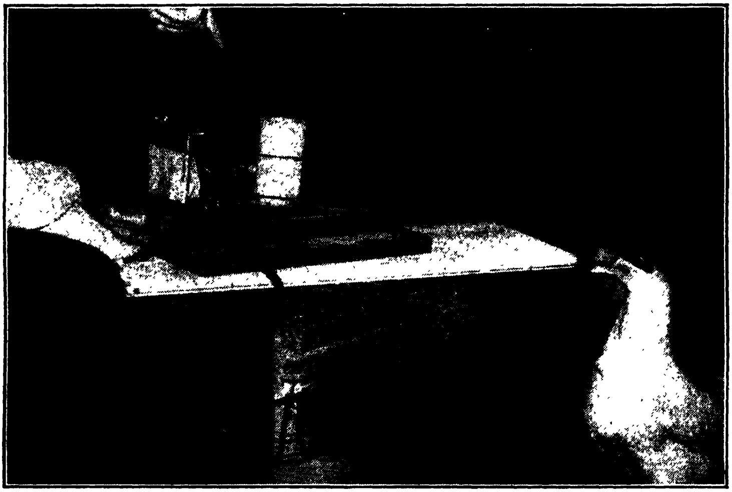
Oats in the ration from the time scratch grain is given to the rearing flock and also through the laying year assist in prevention. The birds may have all the oats they will consume. The oat hull appears to contain an ingredient that reduces the tendency. (See page 111.)

Mechanical devices may be placed on the birds. One type hangs over the vent and others fasten on the beak.

(*c*) *Adults—Debeaking.* As pullets are housed or when picking commences, ¼ inch of the upper beak is cut off. The cut surface must be seared to stop bleeding. A debeaking machine is available at poultry supply houses. The cutting blade is electrically heated, and it cuts and sears at the same time. Debeaking does not interfere with eating or drinking. Feed grain in troughs for at least a few days after cutting.



A.



B.

Fig. 113. Types of cutting for curing and preventing common poultry troubles. *A*. Controlling bumble foot by removing the core from the bottom of the foot. The wound may be disinfected with tincture of iodine and the hole filled with Carbolated Vaseline. *B*. Machine used in debeaking poultry. The lever operates an electrically heated knife.

Canker

There are four recognized forms of canker, according to Beach.[1]

A. Benign canker. Cause unknown. This type consists of small, harmless, yellow patches occurring on the inside of the mouth. It does not spread to the other birds.

B. Malignant canker. Cause unknown. Consists of thick, yellow masses in the mouth, which penetrate deeply. Usually accompanied by loss of appetite, and emaciation. Fatal to the individual. It does not spread to the other birds.

C. Mechanical canker. (See page 246.)

D. Chicken-pox canker. *Cause:* Same as for chicken pox. This is usually accompanied by chicken pox, a nasal discharge, and perhaps a swelling of the face in severe cases. This is the most common form of canker in some parts of the country, and is the most serious of the various forms. It spreads by contact or through the drinking water.

Treatment: Remove the patches with a blunt stick. Paint or spray the sore with iodine and repeat in a few days.

When canker is located around the windpipe, remove with a wire hairpin or similar instrument. Spray the throat with iodine, because if a patch is left its growth continues, finally shutting off the air and causing death.

When canker is accompanied by chicken pox, treat as for chicken pox.

Chicken pox

Cause: A virus[2] which spreads rapidly from one infected flock to another on crates, bags, and clothing or from bird to bird by bloodsucking insects or in the drinking water. Mosquitoes having once fed on a diseased bird may carry the virus to well birds for 27 to 30 days afterward. It may spread rapidly or slowly in a flock or neighborhood. Occasionally a

[1] J. R. Beach, in *Poultry Science,* Vol. 1, No. 1.

[2] Anything which causes a disease and which is capable of multiplying.

few birds in a flock will be affected and upon removal the spread may be checked completely. However, the risk is considerable once the disease is established, and vaccination at that time is advised. Beach[1] states that chicken pox "cannot occur unless the chicken-pox virus is present, although insanitary conditions and poor methods of care and housing make it more likely to occur."

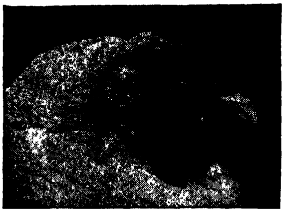


FIG. 114. A bird cured of chicken pox and now immune, but left blind in one eye.

This is a contagious disease. In the early stages, watery, raised blisters are apparent, sometimes accompanied by a foamy discharge from the eyes. Later these blisters change to dark scabs. Cheesy patches may occur in the mouth or throat and the opening into the windpipe (larynx) may become plugged.

In serious cases there is a drop in production and a decrease in the amount of feed eaten, the birds appear droopy, and diarrhea is often present. If the scabs locate on the eyelids, the eyes soon close.

The disease is most severe in late fall or early winter, although it may break out at various times during the year. Young chicks are ocasionally attacked by chicken pox.

Treatment: If the disease breaks out in a *laying flock*, vaccinate immediately with pigeon-pox vaccine. This will check the spread of the disease with less loss in production than if chicken-pox vaccine is used.

Appliances should be disinfected during the outbreak and for several days after apparent recovery.

Vaccination to prevent an outbreak of chicken pox is advisable if the disease has appeared in the vicinity; this plan is preferred by most poultrymen. It differs from the original

[1] Circular 251, University of California.

method. Vaccine made by cultivation of the chicken-pox virus on the chorioallantoic membrane of chick embryos is recommended for preventive vaccination or for use in a flock not in production at the time of the outbreak.

Range pullets 3 to 4 months old may be vaccinated in one of two ways:

(1) *The stick method.* Fasten two sewing machine needles ¼ inch apart in the end of a wooden handle. Dip the points or eye ends into the vaccine and then plunge them through the web of the wing avoiding large bloodvessels. When the needles are withdrawn, vaccine is left on two places above and two below the web.

(2) *The feather follicle method.* Remove three or four feathers from the lower thigh. Apply vaccine to the follicles with a camel's hair brush.

Both methods are rapid. There can be no loss in egg production, as the birds recover completely from the inoculation before they reach maturity and commence to lay. Inoculation does retard growth and reproductive development from 3 to 4 weeks, but there is satisfaction in knowing that the disease need not be feared the following fall and winter. Vaccination renders the birds immune.

Birds suffering from coccidiosis, internal parasites, or other ailments are affected more severely by vaccination than healthy and vigorous birds. They have less resistance, and considerable mortality is likely to occur.

Both types of vaccine may be secured from several laboratories.

Cholera

The germ of fowl cholera is a rather delicate one that lives only a short time outside the body of affected birds. The germ may be present in the nasal chambers of birds that show no symptoms of disease. These carriers and the frankly diseased birds are the sources of outbreaks.

Outbreaks of cholera, in many instances, appear to depend principally

upon bad hygienic conditions. That is to say, outbreaks may occur when birds are overcrowded, in dirty quarters, and in poorly ventilated quarters, even though infection has not been introduced from outside. Outbreaks may also occur under good sanitary conditions, but usually a virulent infection has been brought in from outside through the introduction of diseased birds. Chickens, ducks, pigeons, turkeys, and caged birds may be affected.

Nature of disease: Fowl cholera has two forms. In one the birds die suddenly without significant symptoms. In this type the germ enters the blood stream and quickly kills the bird. Post-mortem examination reveals small white areas on the liver, hemorrhages on the heart and other organs, and mucoid and bloody intestinal contents.

The other type is chronic and produces respiratory symptoms. Affected birds do not die suddenly, and many may recover. The mortality may be large, particularly when complications are present, and the disease spreads rapidly through the flock. A post-mortem examination reveals pus in the nasal chambers and sometimes in the air sacs.

Symptoms: The first form of the disease produces a general depression. When the birds die suddenly, symptoms are not often observed.

The second form begins with "colds." This is accompanied by gasping and by a swelling of the head and wattles. Symptoms of infectious bronchitis must be differentiated from those of this type of fowl cholera. The wattles when first swollen are soft and warm; later they become hard and cold. When the outbreak has subsided, a number of thin birds will be found in the flock. The air sacs in these birds contain pus, which prevents the birds from making a complete recovery.

Treatment and control: When the first type of the disease occurs, affected birds should be isolated. If there is time, an autogenous bacterin should be prepared and an injection given to all unaffected birds. Mixed or stock bacterins are not helpful. Any improvement that may be made in the sanitation of the poultry plant should be carried out immediately.

In the early stages of the second type of fowl cholera, affected birds should be isolated in heated houses if the weather is cold. Heat assists the birds to overcome the disease. Where individual treatment can be applied, the nasal chambers should be washed out with warm water, followed by a few drops of a 15-per-cent argyrol solution. Spraying or dusting the birds has not proven to be of any particular value. Birds kept warm in a sanitary uncrowded condition may recover without additional treatment. After the more acute symptoms of the disease have subsided, the swollen wattles should be cut off and the pus removed.[1]

[1] From Cornell Extension Bulletin 337.

Chronic coccidiosis [1]

This disease may appear in stock 3 or 4 months of age or any time during the first laying year. It may be accompanied by poor or rough feathering, pale condition of head and shanks, emaciation, and possibly heavy mortality. Egg production is decreased. An infestation of worms may produce the same symptoms. A thickened intestinal wall, particularly in the duodenum, may be found.

The disease may be spread to the young stock through adult birds which harbor and give off the organisms (*Eimeria necatrix*).

Most birds have the ability to withstand small doses of the parasites or coccidia. When great numbers are swallowed, their combined forces overcome the bird's natural resistance. It appears, then, that one method of control is to limit the numbers that birds are likely to get.

Old birds should be confined uncrowded in their pens. Obviously diseased birds should be culled, and young stock should be reared where contact with old birds or their droppings cannot occur; later they should be housed with the same precautions.

Proper rearing and later management go far in building a natural resistance against the parasites.

Any birds brought in from another plant, laying tests, or elsewhere may well be quarantined and their feces examined microscopically by a qualified person before the birds are turned loose with the flocks. (See page 488.)

Control: Flowers of sulfur (5 pounds to 95 pounds feed) will prevent infection but not cure *chronic coccidiosis* (*E. necatrix*) or *caecal* (bloody or acute) *coccidiosis*. Sulfur has no effect on other types of coccidia.

Sulfaguanidine is equally good and may be used for any type of coccidia. It is much more expensive than sulfur. Requirements in the ration are:

[1] Acute coccidiosis is discussed on pages 486 to 487.

Chronic (*E. necatrix*), 1½ per cent.

Recent recommendation:

1½% sulfaguanidine 5% sulfur	Feed 1 day in mash.
5% sulfur	Feed next 4 days.

Caecal (*E. tenella*), 1 per cent. (See page 486.)
All other types, 1 per cent but without sulfur.

Other types are:

E. maxima damages the small intestine.
E. brunetti ulcerates and sloughs off the intestinal lining in old and young stock.
E. acervulina produces white streaks across the lining of the upper intestine of older birds.
E. mitis causes diarrhea.
E. praecox and *E. hagani* do little damage.

Colds

When so-called "colds" develop, an accurate diagnosis should be attempted at once and steps taken to reduce the spread of the particular disease.

Colds are now listed under "Respiratory distress troubles." These distress troubles are:

Chicken pox, page 235
Infectious laryngotracheitis, page 243
Infectious bronchitis, page 243
Infectious coryza, page 240
Cholera, page 237
Newcastle disease, page 246
Lack of vitamin A, page 130
Aspergillosis, page 231
Gape worms, page 484
Air-sac mites, page 251
Enlarged liver, page 246
Water pressure or dropsy or water belly, page 242

Infectious coryza

This disease may occur in a mild form with a nasal discharge as the only symptom (simple coryza), or it may include swelling of the face, wattles, or infection in the respiratory tract. In the severe form, coughing, gasping, and sneezing may result.

The disease may last for different lengths of time. Often it spreads slowly from bird to bird in a flock with the result that production although greatly reduced is never zero in the flock as a whole. This loss in egg production in a laying flock may be severe and may make the disease very important economically. Mortality may be considerable.

Coryza is caused by an organism (*Hemophilus gallinarum*) and may be distinguished by isolating this organism. A laboratory examination is, therefore, necessary for positive identification.

Birds which have recovered from the disease act as carriers. Direct contact must be prevented between old birds and the young stock. If the old flock can be disposed of a few days before young stock is to occupy their quarters and the place cleaned, there is little likelihood of transmitting the disease. The organism is apparently short-lived outside the carrier's body.[1] Remedy: ½ per cent sulfathiazole in mash fed 3 to 5 days.

Cropbound

Cause: Some coarse material, such as straw, dried grass, etc., becomes impacted in the crop and blocks the passage.

Treatment: If individual treatment seems desirable, the mass should be removed from the crop. To do this, tie the bird, back down, to a board, and moisten the skin over the crop with a 5 per cent solution of carbolic acid in water. With a sharp knife, make a slit in the skin about 1 inch long, over the center and upper part of the crop. Move the slit

[1] J. R. Beach and O. W. Schalm in *Poultry Science*, Vol. 15, No. 6, 1936, report a series of experiments, in one of which an artificially infected bird was caged for 3 weeks, killed, the exudates removed from the head, suspended in a salt solution, and poured over the litter and mixed with the feed and water. Ten birds were placed immediately in the cages thus treated, 9 others after a lapse of 24 hours, and 4 after a lapse of 4 days. They were left in for periods of 5 to 7 weeks. Only 4 of the 10 placed in the cages immediately contracted the disease. All the remaining birds were proved later to be susceptible.

skin to one side and make a cut in the crop, so that when the skin is released the two cuts will not be directly in line. With the fingers, tweezers, or a blunt stick, gently remove the material through the cuts. Clean out the crop with warm water. With a needle and thread, take three or four stitches in the crop, and also the same number in the outside skin. Disinfect the part. Give a little water, and after a few hours some moist mash. In a day or two the bird may be placed with the flock.

Diarrhea

Diarrhea may accompany any one of several conditions. It is a result and not a cause. The whitish discharge often seen on laying birds may be a nutritional disturbance. It may occur generally in a flock or in a few individuals. If the condition is allowed to continue, sores which resemble vent gleet may develop, or, after a time, the birds may recover. Diarrhea often occurs with tapeworm infestation or in the later stages of tuberculosis. Greenish diarrhea may be a symptom in fowl typhoid, while greenish or yellowish diarrhea may indicate fowl chlorea.

Dropsy

Fluid collects in the body cavity and may enlarge the abdomen. *Cause:* A slight disorder of the lining of the body cavity. "No one specific causative agent is responsible. The accumulation of fluid results from a filtration of blood serum through the serous membranes of the intestine, or the peritoneal covering of the abdominal cavity. . . . It may be present in . . . debilitating diseases affecting the abdominal organs." [1]

Treatment: It is best to dispose of the bird.

Enlarged or pendulous crop

Cause: A condition due to general weakening of the crop muscles. It is thought to be inherited in turkeys. It may be

[1] Ward and Gallagher, *Diseases of Domestic Birds.*

associated with either cropbound or sour crop troubles, in chickens.

Treatment: Generally, the bird will remain productive unless the crop is so large as to be in the way while eating. If detected early, the bird may be dressed and used, unless she has lost flesh. Should one desire to save the bird, a portion of the crop may be cut out and the crop sewed up. Generally, the best plan is to kill and bury the bird, when she ceases to lay.

Impaction of the oviduct

Cause: An accumulation of material resulting from inflammation and stimulation of the oviduct glands which hardens in the oviduct and which may later decompose.

Treatment: There is no satisfactory treatment.

Infectious bronchitis

This disease has the same symptoms as infectious laryngotracheitis except that there is no expulsion of blood mucus. Recovery results in immunity. Treatment is not successful. The sources of the disease are not known. Incubators should be cleaned and fumigated between hatches as a precaution against the spread of the disease.

Adults. The disease occurs in a mild form, spreads rapidly, mortality is low, and egg production is decreased. In a week or two the disease will have run its course, but egg production may be delayed for several weeks.

Chicks. Mortality may be considerable.

Control. Immunization. About 10 to 15 weeks of age, if the disease is nearby, give several birds the disease and place with the balance of the young stock. These birds rapidly spread the disease and immunize the flock against a later attack.

Infectious laryngotracheitis

Cause: A filterable virus which finds its way into the eyes, nostrils, or the windpipe. The disease is not in the blood,

hence is not spread by bloodsucking insects. It may spread very rapidly, reach the peak in 7 to 8 days, then subside and disappear in 14 to 21 days. The mucus and clotted blood obstruct the air passages, and, if not coughed up, the bird may strangle. Death is due entirely to suffocation. The coughing and gasping may be accompanied by a rattling of the mucus in the windpipe.

Birds recovering may be immune but become carriers of the disease and may transmit it to others. Once introduced it is carried over from year to year by the bird "carriers" in the flock.

The virus must first come to a farm from some outside source, through purchased stock or birds from laying tests or shows, visitors, crates, bags or other transferable equipment. The virus does not spread on the shell of eggs except under unusual laboratory conditions.

Treatment: Prevention is best. Use caution when introducing adult stock to the plant.

If the disease is discovered its spread may be prevented by vaccinating all unaffected birds. An *accurate diagnosis is necessary* before vaccinating because the vaccine will not protect against other diseases that look like laryngotracheitis.

Disposing of all birds and thoroughly cleaning and disinfecting the house and equipment before restocking are likely to be successful. However, the disease may be brought in again by the same means as at first. Hence, extreme caution should be exercised.

When pullets are to be kept on a farm where there are carriers present, the chicks should be vaccinated when about 6 weeks old. This produces an immunity; however, this treatment is fatal if the virus gets into the respiratory tract.

Vaccination: E. L. Brunett has discussed vaccination thus: [1]

The vaccine is applied to the bursa of Fabricii, which is on the upper side of the vent. The bird is held by an assistant, and the upper

[1] *Poultry Diseases,* Cornell Extension Bulletin 337.

part of the vent is rolled open with the thumb and the forefinger. A stiff brush moistened with the vaccine is inserted into the bursa and is brushed back and forth several times. Some prefer to place the vaccine in the bursa with a syringe. Some practice is necessary before one can become proficient with either method. Five days after vaccination, a swelling of the upper part of the vent should be evident. This indicates a "take." Birds not showing this "take" should be revaccinated. It is rather difficult to get 100-per-cent "takes" in one vaccination.

Caution: Birds contracting the disease in the natural manner may continue as carriers for months or perhaps for life.

The virus does not persist in the cloaca longer than 10 days after vaccinating. Hence, such vaccinated birds will not spread the disease to other birds on the same or other farms after that time.

Internal hemorrhage

Cause: The cause may be the same as that of apoplexy. Rough handling of the bird or tumorous growths may cause a rupture of the liver.

Internal layer

Cause: This may be due to a ruptured oviduct or to the incomplete functioning of the oviduct at the time when the ovule breaks loose from the ovary (page 433). In this case the funnel-shaped opening of the oviduct does not pick up the ovule, and it rests in the body cavity.

Occasionally, reverse peristaltic action of the oviduct takes place, and forces the complete egg from the uterus at the end of the oviduct back and out of the funnel-shaped opening, into the body cavity. Hens have been opened and found to have several completed eggs floating free within the body.

Treatment: None. It is better to dress and use the bird.

Limberneck

Cause: A paralytic condition resulting from the eating of toxins present in decaying meat and spoiled food. Flies or

larvae feeding on such material take these toxins into their bodies. Fowls eating such flies or larvae may show symptoms of the disease.

Treatment: It is usually best to bury the carcass. Eliminate the cause.

Lymphomatosis (big liver)

This disease (page 247) is an expression of the avian leucosis complex. Various tumors are thought to be associated with avian leucosis. At times, tumor tissue is diffused through the liver tissue, leaving it greatly enlarged, and with a puffed-up, grayish, spongy, roughened surface. The borders are round. The organ may grow to several times its normal size. It ruptures easily and birds often bleed internally, with death resulting.

The disease takes weeks or months to develop to a point where it shows externally. During this time the bird's comb and color appear normal. Toward the end, the bird may become weak and pale about the head.

The disease can apparently be transmitted from affected birds by contact or by contact with contaminated litter or soil or it may be spread by mites or other bloodsucking insects.

Treatment: Proper rearing (page 265) is best for prevention. Careful culling should be practiced.

Mechanical canker

Cause: A foreign body in the eye or other part. Irritation is started, and a white, cheesy material forms about the object. There is no running at the nose.

Treatment: With a toothpick, remove the mass. The foreign material will be found in it. The bird may be released without further treatment.

Newcastle disease

A relatively new disease introduced a few years ago from Asia by way of England to the West Coast where it was and

still is called avian pneumoencephalitis. In 1945 it appeared in New Jersey and later throughout the Northeast.

Symptoms: Young Chicks: The onset of the disease is sudden and it spreads rapidly. A respiratory infection similar to bronchitis occurs. The chicks cough, sneeze, and may have a slight nasal discharge. Mortality is heavy and may reach as high as 90 per cent. Nervous symptoms in the form of twisted heads and necks and partial or complete paralysis occur in about 5 per cent of the affected birds. These symptoms may occur at the same time as the respiratory infection or after the respiratory symptoms have subsided.

Adult Birds: Respiratory symptoms occur similar to those seen in chicks. Relatively few old birds, if any, become affected with nervous symptoms. Mortality is negligible. Egg production drops rapidly and in about a week ceases almost entirely. The birds recover and eventually come back into full production. For several weeks after recovery eggs may have abnormal shells, many air cells loose and bubbly, and weak albumen.

Cause: Virus.

Treatment: Control by vaccination. Communicate with the county agricultural agent or poultry disease laboratory.

Fowl paralysis

This term, once thought to refer to a single disease, is known to cover a series of troubles, spoken of as "avian leucosis complex," all related somewhat to nerve disorders. Because the disease expresses itself in different forms, it is spoken of as neuritis, neurolymphomatosis, leucosis, range paralysis, iritis (an eye abnormality), and big liver disease. Tumors are thought to be an expression of the same disease. Various other forms are found in the blood and bones. The disease works slowly, requiring weeks or even months before becoming apparent to the observer. During this period, body weight and production may be unaffected. In the later stages of the disease, egg pro-

duction drops, if development has proceeded that far, and finally death results.

In nerve paralysis of legs or wings, the bird may still be laying and a picture of health after she starts losing the normal use of her legs or wings. This form is the one most easily seen. At first one or both legs appear to be handled awkwardly, later they became useless and are extended full length in front or in back of the body as the bird rests on the litter; or one or both wings may hang down, the bird being unable to control them.

Iritis occurs when the iris of the eye becomes diseased. The pupil itself appears irregular or may be nearly or completely covered by the iris, causing blindness. Regardless of color, an irregular iris that is unresponsive to light is ordinarily associated with leucosis and blindness. Formerly the *gray eye* was regarded as an undesirable feature associated with leucosis. However, the actual color may not be a symptom. (See page 13.)

The *cause* of fowl paralysis or avian leucosis is not known.

Fowl paralysis is apparently not affected by the usual rations or methods of feeding. Chicks are usually susceptible during the first 5 months. The disease apparently runs itself out or assumes different forms on a particular farm after a period of years. This, however, is too long and costly a method to be depended upon.

Preventive measures. There is no known cure for the disease. Studies in developing resistant strains are in progress. Certain families are resistant to the disease and, if the progeny test is being used in the breeding plan, these birds may be found and used as breeders.

Pullets should not be used as breeders on farms where the disease is present. Chicks from such pullets are much more likely to get the disease than are chicks from hens on the same farm.

Rear by the carrier elimination theory. (See page 265.)

Pickout

See cannibalism.

Prolapse of oviduct

In the process of laying, a larger part of the oviduct than usual is left protruding from the vent. Occasionally the oviduct containing the egg will hang from the vent. Possible *causes* are eggs too large for the oviduct opening or restriction of it through swelling. This prevents the easy passage of the egg, causes the fowl to strain in an effort to expel the egg, frequently results in breaking the membranes with consequent eversion, and often starts the vice of cannibalism or "pickouts." It frequently occurs with pullets in the fall or early spring and may occur with hens.

Treatment: In most cases, kill and use the bird. When individual care is justified, wash the dirt off with warm water, apply Carbolated Vaseline, break and remove the egg, if there, and gently push the mass back into place. Keep the bird by herself for a few days.

Ruptured yolk

Pullets with the ovary full of yolks may, when suddenly frightened, subject their bodies to a sudden jar, causing the yolk sac to tear or break.

There is no treatment except to prevent the cause by making the birds as tame as circumstances permit.

Inflammation of the crop (sour crop) or thrush

A disease caused by fungi, which may cause small, slightly raised, whitish nodules on the inside crop lining. It may occur in young or old birds, but is likely to be more serious in chicks.

The crop contents become very sour. If detected early, give one level teaspoonful of powdered blue stone (copper

sulfate) to each 2 gallons of water, every other day for a week.[1]

In advanced cases kill the bird.

Tuberculosis

Cause: Fowls become infected by eating food, soil, etc., on which germs from the droppings of tuberculous fowls are deposited.

Treatment: The disease is incurable. Eliminate all birds suspected of being tuberculous. Where flocks are badly infected, the best authorities recommend disposing of all birds. The disease, it is believed, is not transmitted through the egg, and therefore pullets reared on new ground and in clean buildings should be disease free. Disinfect the houses and equipment. Work the soil. Sunshine kills disease germs. Vacate both houses and ranges for several months, then start again with new healthy pullets. Keep only pullets for several years.

Manage the flock to insure strong, high-vitality birds which are able to throw off the disease.

The diagnosis of tuberculosis in the living fowl is possible by means of the tuberculin test, which is made by injecting $\frac{1}{15}$ to $\frac{1}{20}$ cubic centimeter of a substance known as tuberculin into the skin of the wattle. If an injected bird has tuberculosis, the wattle will swell within 48 to 72 hours.

Tumors

Cause and treatment not definitely known.

Vent gleet

Cause: The cause has not been fully determined. It is evidently a venereal disease spread in the flock, principally by the male. The cankers in the vent have a putrid odor.

Treatment: Remove all affected birds. Examine the vent of the male carefully for the symptoms. Vent gleet usually

[1] E. Jungherr, "Diseases of Brooder Chicks," Bulletin 202. University of Connecticut, Storrs, Connecticut.

starts with the female and is then spread to other hens by the male. It is seldom worth while to attempt a cure, although softening with Carbolated Vaseline and painting with iodine may help.

Air-sac mites

Cause: Small, yellow mites in the air passages and air sacs. The lining of the air passages is irritated by their sucking mouth parts (Fig. 115). The trouble is serious and it is difficult to rid a flock of it.

When not badly infested, birds show no signs of this trouble. After the mites become numerous enough to cause discomfort, the comb turns purple and the bird may cough and wheeze. In the movement of the body the bird appears awkward, and has a peculiar appearance of the back and shoulders, which gives it a more or less "hunched up" attitude.

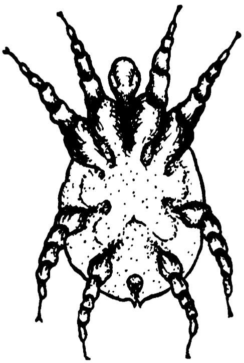


FIG. 115. The air-sac mite. Drawn from specimen under the microscope. (Greatly enlarged.)

Treatment: Remove suspected birds, kill, and examine the carcasses. If air-sac mites are found, cull rigidly. It is doubtful if a flock can be entirely rid of them, but they can be kept down. The only sure way of ridding the flock is to kill off and start new as outlined under tuberculosis. Keep young fowls.

Caecal worms

Beach[1] makes the following statement regarding this parasite:

These tiny parasites, measuring ½ to ¾ of an inch in length, are found in the caeca or "blind guts" of the intestines. On account of their small

[1] Circular 251, University of California.

size they are often overlooked by poultrymen or taken for the young of intestinal roundworms and their harmful effects are minimized or ignored. Their presence on the wall of these organs interrupts their normal functioning and in the case of baby chicks may result in death as early as the tenth day.

They injure the intestinal walls and permit the entrance of disease germs such as "black head." Otherwise, their presence in small numbers seems to have no ill effects.

Treatment: When the flock is affected with large numbers, mix phenothiazine in a mash, ½ gram per bird, 1 ounce per 100 birds, or 1 pound per 1000 birds and feed enough to last an hour or two.

Fowl ticks [1]

Found in the Southern States. The tick lays its eggs in cracks about the house or runs. Larvae find their way to the birds, and feast on the blood of the host for 4 to 10 days. Later, as nymphs, they feed again for a part of a day.

The adult tick is flat, egg shaped, dark brown, from ¼ to 7/16 inch long, and half as wide as it is long.

Treatment: It is difficult to treat the birds with any effective substance, as the power of resistance of the tick requires a material so strong as to harm the bird. It is best to make the attack by treating the houses. Saturate the cracks and crevices with a strong spray, such as crude carbolic and kerosene (1:3). Paint the roosts and cracks with Carbolineum. Watch for the ticks. Treat the houses every month or two if necessary.

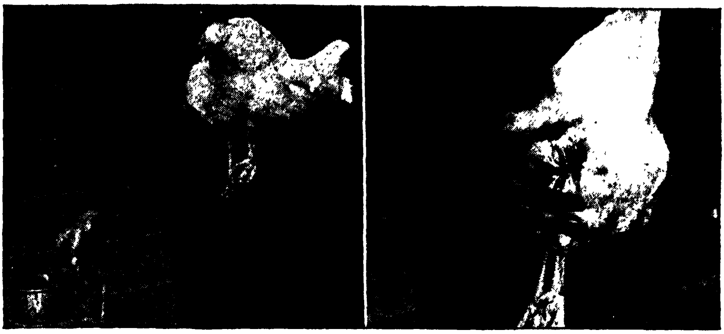
Lice

Several species of lice use the domestic fowl as a host. They possess biting mouth parts, and irritate the bird by crawling as well as by biting the old scales, which serve as food. Lice spend their entire life on the fowl. The eggs are laid around

[1] Patton, *Poultry Science,* Vol. 1, No. 4; Beach, Circular 251, University of California.

the bases of the feathers, usually just below the vent and under the wings. Lice vary in size, some being very small and some ⅛ inch long or longer.

Treatment: Fortunately, lice are easily controlled, and anyone using ordinary precautions may keep the flock "louse free." The proper use of any of the following should prove effective.



A. B.

FIG. 116. Applying blue ointment. *A*. Hold the bird as shown and take a small amount of ointment on the forefinger. *B*. With the thumb and middle finger, part the feathers below the vent and with the forefinger apply the ointment to the skin, rubbing it on and leaving no chunks. Avoid placing ointment on the vent.

(*a*) Carbolineum will control body lice if it is properly applied to the perches as a mite preventive. Its effect ordinarily lasts 1 year.

(*b*) Blue ointment may be purchased at any drug store. It is easily applied and very effective. The flock should be treated twice each year, spring and fall. The effect of the ointment continues for the time between. With the finger, apply a piece about the size of a pea on the skin beneath the vent. Give two or three rubs to make sure that no large pieces remain on the feathers. Place the same amount under each wing, on the bare spot at the base of the wing (Figs. 116, 117). This is a poison and should be handled cautiously.

(*c*) Sodium fluoride,[1] a white powder, may be secured at the drug store. Hold the bird head down and scatter a few pinches through the feathers of the breast, thigh, below the vent, on each side of the back, neck, and on the head.

Repeat when necessary, perhaps twice a year.

C. D.

FIG. 117. *C*. With the left hand still holding the legs, turn the head of the bird to your right. Tip the bird back until she rests on your left arm. With the thumb and middle finger, push the wing back and the body feathers down, respectively, and apply the ointment to the bare spot thus exposed. *D*. Tip the bird over on the knee as shown, and with the little finger and the thumb, push the wing back and the feathers away, respectively. Apply the ointment as usual.

(*d*) Blackleaf 40 is expensive but quite efficient. Place in an oil can, and, about 1 hour before the birds go to roost, make two lines of the liquid on each perch. The saving of labor in applying is considerable when compared with other methods. It is best used in summer.

Red mites

These are very small and difficult to see during the afternoon or toward evening. At this time they are gray. After feeding, they are gorged with blood and are red.

[1] First advocated by the Bureau of Entomology, U. S. Department of Agriculture.

The mites do not stay on the birds constantly. They spend the day on the under side of the perches or in cracks and crevices near by. At night they crawl on to the birds and fill themselves with blood, piercing the skin with their sucking mouth parts. Before morning, they leave to spend the day near by, digesting the blood.

Mites breed rapidly, increasing in numbers at an astonishing

Fig. 118. Applying sodium fluoride.

rate during warm weather. Filthy conditions aid their breeding.

After a few days of warm weather, if they are allowed to go unchecked, great clumps and masses of the mites may be found. Examine the under side of the perches and the places where they rest on the perch supports. In all probability a wriggling mass will be seen. If left unchecked, mites will be found in cracks in all parts of the house, more especially where birds roost in several places about the house or shelter. The mites are surprisingly tenacious of life. They survive several years after the building has been unused by fowls.

Mites sometimes infest the nests and feed on birds which go on the nest to lay. They cause a decrease in egg production, and very frequently death results from their attacks. It is

impossible for birds to function normally where the red mite is present.

Small grayish specks, the cast-off skins, indicate the presence of mites.

Control: When the mites are about the roosts and nests only, the control is comparatively simple. Paint the roosts, roost supports, and nests with Carbolineum or other good mite repellent.

FIG. 119. Applying sodium fluoride.

Carbolineum holds its strength for several months. During this time it retains its power to repel mites and at the same time proves effective in combating body lice and disease germs.

Carbolineum is not a coal-tar solution, nor is it soluble in water or petroleum oils. Its efficiency is not due to its content of tar acids, as it contains less than 2 per cent of such. The germicidal or vermicidal effect of Carbolineum is due to the fact that it passes through a process of chlorination and for this reason also it does not mix with petroleum oils, and the genuine goods if mixed with such will invariably show a sticky precipitation which will clog the sprayer as well as the brush. For use in poultry houses, Carbolineum is always recommended to be used full strength.[1]

[1] From descriptive material published by the company, and quoted because the statements seem to be borne out in practice, in cases where there has been opportunity to use Carbolineum in various ways.

When the entire house is infested, a thorough cleaning and spraying are necessary to rid the house of the pests.

Brooder houses should be examined before chicks are placed in them during the brooding season. If mites are allowed to prey upon young chicks, the results are disastrous.

Disinfectant danger in brooders. Coal-tar products (cresylic acid types) are a source of danger when improperly used. If they are not dried thoroughly or washed out after disinfecting, the fumes resulting when these products are heated by the brooder stove cause death or serious disability. Disinfect or paint brooder houses, and, when they are reasonably dry, wash them out with cold water.

There is no similar problem with hens.

Roundworms

Roundworm-infested flocks as a rule are unprofitable. Young stock are more seriously affected than mature stock. The failure of pullets and cockerels to develop properly is very often caused by these worms.

There are several kinds of roundworms that infest poultry. The spread of these parasites and the methods of treatment are the same for all.

Fertilized eggs are given off in the droppings, and after a period of a few days at favorable temperature and moisture are ready to hatch when taken into the body by a bird. The minute eggs cling to grain or other food eaten by poultry or may enter the body through drinking water. The infestation is direct, that is, the worm eggs pass from one bird to another without the need of an intermediate host.

The most certain way to detect roundworms is to kill some of the birds and examine the intestines their entire length. The large roundworms of poultry are white, pointed at both ends, and from 1 to 3½ inches in length (Fig. 110). They are unattached in the intestine.

Tobacco dust for flock treatment or nicotine sulphate capsules for individual treatment are effective for expelling roundworms.

It is not advisable to use any treatment if the birds are laying heavily.

Method of treatment with tobacco dust. To each 50 pounds of dry mash add 1 pound of tobacco dust, containing 1½ to 2 per cent nicotine, and mix thoroughly. Not over 1 week's supply should be mixed at one time. Feed this mixture to the birds in place of the regular mash. No other change of feeding is necessary, provided the method used has proved satisfactory. Feed the tobacco dust daily for 3 or 4 weeks. Clean the droppings and litter frequently.

It is often advisable to feed tobacco dust daily to young chicks for periods of 3 or 4 weeks, with 3 or 4 weeks in between during which time no tobacco dust is fed. The chicks may be fed in this manner from 2 or 3 months of age until they reach maturity.

Since there is no practicable method of destroying worm eggs in the soil, young stock should be reared on new range. The contaminated runs or range should be plowed, and poultry and poultry manure kept away from it for at least 2 years.

Scaly leg mite

Scaly leg is caused by a microscopic mite which burrows beneath the scales of the shank, causing the scales to stand out. In very severe cases, the shanks have great knobs, parts of which may be cracked and bleeding. The trouble is likely to spread.

Treatment: Dip the shanks in a mixture of crude oil and raw linseed oil, equal parts. Do not let the mixture come in contact with the skin above the shank.

Pearl, Surface, and Curtis [1] recommend the application of an ointment (1 part oil of caraway and 5 parts white Vaseline, mixed) rubbed in every few days until the trouble disappears.

The first method is somewhat easier.

Dipping the shanks in kerosene is also effective.

[1] *Poultry Diseases,* The Macmillan Co., New York.

THE PREVALENCE OF POULTRY DISEASES AS SHOWN BY THE DIAGNOSTIC WORK OF THE NEW YORK STATE VETERINARY COLLEGE AT CORNELL UNIVERSITY FOR THE YEAR JULY 1, 1945, TO JUNE 30, 1946 *

Number of Birds That Died and Cause of Loss

Disease	Chickens	
	Under 3 months	Over 3 months
Specific contagious diseases		
Aspergillosis	3	3
Avian encephalomyelitis	19	
Cholera, acute		2
Coccidiosis (chickens)		
E. acervulina	33	27
E. brunetti	15	2
E. maxima	21	15
E. mitis	4	2
E. necatrix	70	22
E. tenella	93	3
Mixed intestinal	10	17
Coryza	4	24
Enter-ohepatitis	36	
Fowl pox	5	22
Fowl typhoid, acute		5
Infectious bronchitis	15	11
Laryngotracheitis	1	4
Listerellosis		1
Newcastle (pneumoencephalitis disease)	33	14
Paratyphoid		
S. sp.	2	
S. oranienburg	1	
Pullorum disease		
Acute, mature birds		29
Chronic, mature birds		43
Chicks and poults	247	
Trichomoniasis	1	
Tuberculosis		12
Avian leucosis complex		
Lymphomatosis		
Ocular		24
Neural	37	96
Visceral	4	196
Myelocytomatosis		9
Osteopetrosis		9
Miscellaneous conditions		
Abscess	3	6
Anomaly		1
Atresia of vagina-crossed beak	1	
Subaortic interventricular defect	1	

THE PREVALENCE OF POULTRY DISEASES AS SHOWN BY THE DIAGNOSTIC WORK OF THE NEW YORK STATE VETERINARY COLLEGE AT CORNELL UNIVERSITY FOR THE YEAR JULY 1, 1945, TO JUNE 30, 1946 (*Continued*)

Number of Birds That Died and Cause of Loss

Disease	Chickens	
	Under 3 months	Over 3 months
Miscellaneous conditions (*Continued*)		
Air-sac infection	3	5
Anasarca	1	
Arthritis (non-specific)	1	1
Arthritis (staphylococci)	1	2
Arthritis (uremic)		1
Bumble foot	1	8
Bursitis, keel		2
Cannibalism		13
Cataract	1	
Cloacitis (vent gleet)	2	1
Colibacillosis		1
Conjunctivitis	1	
Cysts (epidermic)		1
Depraved appetite	2	
Dermatitis		2
Edema (subcutaneous)	1	
Emphysema (subcutaneous)		1
Enteritis (non-specific)	4	9
Foreign body in mouth		1
Gout, visceral	1	12
Granuloma		1
Gut-tie	2	
Hematome		2
Hemorrhage, external		4
Hemorrhage, internal		14
Hepatic necrosis	4	12
Hepatitis (non-specific)	3	8
Impaction, crop	1	6
Impaction, gizzard	7	9
Impaction, intestine	6	3
Impaction, oviduct		25
Internal layer		24
Intussusception	2	
Keratitis	2	
Myocarditis	1	2
Nephritis	22	23
Nephrosis	1	5
Omphalitis	7	
Otitis media		1

THE PREVALENCE OF POULTRY DISEASES AS SHOWN BY THE DIAGNOSTIC WORK OF THE NEW YORK STATE VETERINARY COLLEGE AT CORNELL UNIVERSITY FOR THE YEAR JULY 1, 1945, TO JUNE 30, 1946 (*Continued*)

Number of Birds That Died and Cause of Loss

Disease	Chickens	
	Under 3 months	Over 3 months
Miscellaneous conditions (*Concluded*)		
Pendulous crop		5
Pericarditis (non-specific)	4	4
Peritonitis	4	38
Peritonitis, ruptured yolk		22
Pneumonia (non-specific)	2	7
Poisoning		
Arsenic		1
Chloropicrin		1
Naphthalene	1	
Prolapse of oviduct		8
Prolapse of intestine	1	1
Proventriculites, acute	2	
"Pullet" and "bluecomb" disease	6	49
Ruptured kidney		2
Ruptured liver		11
Sinusitis (non-specific)	2	7
Streptoccosis		1
"Stunted chick" disease	23	
Suffocation	1	
Tendovaginitis		3
Trauma	3	5
Tumor (unclassified)	3	70
Typhlitis		3
Parasitisms		
Nematodes		
Ascaridia galli	5	33
Capillaria columbae	3	28
Cheilospirura hamulosa		3
Tetrameres americana	1	1
Cestodes		
Choanotaenia infundibulum		1
Davainea proglottina		6
Hymenolepis carioca		2
Railletina cesticillus		4
Taeniasis (unidentified)		1
Lice		7
Dermanyssus gallinae		1

THE PREVALENCE OF POULTRY DISEASES AS SHOWN BY THE DIAGNOSTIC WORK OF THE NEW YORK STATE VETERINARY COLLEGE AT CORNELL UNIVERSITY FOR THE YEAR JULY 1, 1945, TO JUNE 30, 1946 (*Continued*)

Number of Birds That Died and Cause of Loss

Disease	Chickens	
	Under 3 months	Over 3 months
Nutritional diseases		
A-avitaminosis	2	5
Gizzard erosion	9	1
Malnutrition		2
Perosis	1	1
Riboflavin deficiency	2	
Rickets	18	6
Decomposed	32	12
No diagnosis	214	153
Totals	1075	1303
Counted twice	173	521
Net totals	902	782

* Report by P. P. Levine, M. S. Hofstad, and J. H. Gillespie, Department of Pathology and Bacteriology.

Sticktight flea

The adult fleas attach themselves to the head, about the eyes and comb. Eggs are laid and fall to the ground, as a rule. There they hatch and, when grown, return to the bird. The flea is more common in the warmer sections of the country.

Control: Thoroughly spray the houses with crude carbolic and kerosene (1:3), clean the place thoroughly, and treat the roosting quarters as for mites. It is probable that treating the birds as for lice, page 252, will help.

Tapeworms

These worms fasten themselves to the walls of the intestines, by means of hooks in the head end. The body of the

parasite is segmented, the segments growing larger the farther they are from the head. The older segments develop sexually and become filled with eggs. These segments drop off, pass out with the droppings, disintegrate, and the eggs are eaten by an intermediate host, such as a slug or certain types of beetles. Later these may be eaten by a fowl, and the cycle is completed.

Treatment: No treatment is known that is 100 per cent efficient. As an intermediate host is necessary for subsequent infestation, control consists in breaking the cycle. Remove droppings and litter frequently and carry them far enough away so these hosts will not be likely to find their way from them into the poultry houses. Spread the manure, or store it in tight or screened containers. In tight containers heat will destroy not only the eggs but also the fertilizing value of the manure. In screened pits intermediate hosts may not enter.

Several remedies have been tried [1] but have not been found effective in removing the tapeworm heads although certain of them remove the bodies. The bodies grow out again in 1 to 2 weeks. The best treatment is prevention.

Rear on clean ground where no manure has been spread and no chickens have ranged for at least 2 years. An open range is preferred. Avoid naturally damp, shaded areas. Rotate ranges. Consider the possibility of infestation from neighboring poultry plants.

[1] Under date of October 18, 1932, the Food and Drug Administration of the U.S.D.A. issued a trade notice as follows: "Government tests showed definitely that these types of preparations [combinations of nicotine sulphate and kamala and also iodine products], although labeled as being effective for roundworms and tapeworms in chickens and turkeys, are not effective in expelling any species of tapeworms which commonly infest chickens and turkeys nor any species of roundworms other than the large roundworm. No drug or mixture of drugs known at the present time can be truthfully offered to the public as an expeller or vermifuge for all types of worms which infest poultry and other animals." *Poultry Science,* January 1933.

Tropical or Northern mite

Heavy infestation may cause emaciation, lowered egg production, and general debility.

Treatment: Dust with flowers of sulfur and paint the perches with Blackleaf 40. Individualized treatment with carbolized Vaseline applied about the tail and under the wings appears most effective. Proper sanitation about the house will help in avoiding the trouble.

Heat prostration

Heat prostration frequently causes the death of the very best birds, which are overcome by heat during the process of egg laying, in nests or in buildings that are not properly ventilated.

On extremely warm days sprinkling the floor and walls has a cooling effect. The outside of the house is sometimes sprayed with water during the period of most intense heat. The evaporation of moisture inside or out is a cooling process.

Egg eating

This vice seldom develops among birds that are kept occupied, have proper feed and range, and whose nesting material is sufficient. Gather the eggs frequently. Deepen the litter and darken the nests. See that ample oyster shell and fish oil are supplied. Provide for direct sunlight.

Feeding milk for a few days may help.

In an attempt to get the birds' attention on other matters, throw any feed or material, such as waste paper, in the pen for the hens to tear up.

2. Controlling disease by the carrier elimination method

Through a series of tests, while attempting to reduce the mortality which was steadily increasing in the station flock, poultrymen at the Ohio Agricultural Experiment Station have made important discoveries.[1]

[1] Summarized from Ohio Agricultural Experiment Station Bulletin 180.

First. Although a few diseases and parasites live over from year to year in the soil, other very important ones can remain virulent but a short time (2 to 4 weeks) outside the bird's body.

Second. The following appear to belong to the second group: paralysis, lymphomatosis (big liver disease), fowl typhoid, cholera-like diseases, infectious coryza, and infectious laryngotracheitis.

Third. Chicks and growing pullets were highly susceptible to the diseases, and, despite all measures (of sanitation management such as open wire sun porches, fly screening, batteries, and fresh range), became infected from the older birds which served as *carriers* of the diseases, when kept on the same farm. This occurred even when the old birds were housed or yarded separately or when the chicks and pullets were raised on fresh range ¼ mile away and entirely segregated from all other chickens.

Fourth. These diseases are apparently not transmitted through the egg. Chicks may, therefore, be hatched from either an affected or a non-affected flock.

Fifth. Chicks should be brooded and pullets reared to *at least 5 months* on other farms where these diseases do not exist, or completely segregated from older birds.

Sixth. Four weeks before housing the pullets, dispose of all the old birds (*carriers*), and thoroughly clean the houses and equipment.

COMMUNITY SURVEY

1. Secure several birds suffering from various troubles, and keep them in well-ventilated quarters, under good management. Treat each one for its particular trouble. Keep account of the time consumed in preparing and giving the treatment and the cost of time and materials. At the end of a week or more, study the data and the quality of the birds, and determine the advisability of attempting a cure. (This should prove more valuable if data are secured on several lots of birds.)
2. How much emphasis do local poultrymen place on attempting to cure sick birds?

3. What methods are used in your locality in keeping poultry free from lice and mites?

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CHAPTER XIII

MAINTAINING SANITARY CONDITIONS

Among the more important factors having to do with the success or failure of the poultry enterprise are poultry hygiene and sanitation. One can easily realize that a flock possessing high vitality and vigor, free from parasites, and with proper feed, water, housing, and range, is happy and stands a better chance of remaining free from disease and troubles.

These essential conditions may be secured by anyone at a slight expense. Failure to keep the place clean is the weak spot in the management of many poultry plants, and yet the task of maintaining cleanliness is not difficult or unpleasant when followed systematically with modern poultry plant conveniences.

Since poultry is naturally hardy and can withstand considerable ill treatment, many poultrymen permit the flock to live under filthy, unsanitary conditions. As a result of disease and other factors, losses of birds, reduced egg production, and general lowering of flock vitality may occur. These more than offset any expense that might have been incurred in providing sanitary conditions.

Cleanliness is of paramount importance in providing sanitary conditions. There are several operations which should be thoroughly and regularly performed in the general care of the poultry house. These are the first requisites in maintaining a clean house.

Operations:

1. Removing droppings.
2. Renewing litter.

3. Cleaning and disinfecting in the fall.
4. Removing and disposing of sick and dead birds, feathers, and dressing waste.

General information:

Spray material for disinfection and disease prevention.

1. Removing droppings

Remove the droppings each 2 or 3 weeks in summer. During winter, clean when the droppings are not frozen. Where no platforms are provided, straw or other absorbents should be used freely.

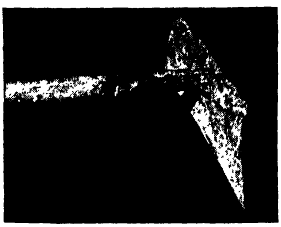


FIG. 120. A droppings-board scraper. Note the pointed sides for cleaning in corners.

Use a hoe, a square shovel, or a regular droppings board scraper (Fig. 120). Clean all corners and do a thorough job.

After the manure is removed, scatter an absorbent, such as superphosphate or litter, over the droppings boards. An excellent practice is to scatter 3 or 4 pounds of superphosphate on the droppings boards to each 10 or 12 pounds of manure secured at a cleaning. (Ordinarily 100 birds will void 10 to 12 pounds of droppings during a roosting period of approximately 11 hours in the winter.) This takes up the moisture and will be mixed with the droppings at the next cleaning. It acts as a preservative and makes a desirable fertilizer for garden and general crop purposes. Coal ashes may be used in place of the superphosphate. Where the manure is saved as a fertilizer, it is best to store or spread it with the other farm manures. However, if it is desired to use poultry manure separately, the best place to store it is in a covered pit or room arranged so that water cannot run in on the floor. This room or pit should be well ventilated near the roof. All openings and doors should be screened to keep flies from entering and breeding in the manure.

2. Renewing litter

Straw put in in the early fall and added to from time to time until several inches deep should become broken up into small pieces before cold weather arrives. Such litter may be left in for an entire year. It is called "built-up" litter. It is best not to change litter during the winter since long straws or large pieces of litter material become damp and filthy sooner than a well pulverized litter, because smaller pieces provide more surfaces for the evaporation of moisture.

A good ventilation system, dry litter near the water vessels, and the proper floor space per bird aid in keeping the litter dry. So long as the litter is dry it may be left on the floor, at least during the winter.

Keep the litter stirred; otherwise it may be lumpy and wet. Feeding some grain in the litter each day causes the birds to scratch and keep it well mixed. The moisture from droppings is quickly evaporated.

Superphosphate and *hydrated lime* aid in improving the litter condition. Superphosphate, about 25 pounds to 100 hens, scattered over droppings and litter improves the fertilizer value also. Hydrated lime, 1 pound to 3½ to 4 square feet of floor space, repeated when necessary, has recently been recommended and used. The loss of ammonia, formerly attributed to the use of lime, has been greatly discounted. Lime improves the physical consistency by coating the litter particles. *Quick lime* should not be used, as it increases fire risk.

3. Cleaning and disinfecting in the fall

A thorough cleaning and disinfecting should be given to laying houses at least once each year before the new pullets are placed in their permanent quarters. The older fowls may occupy adjacent pens or barracks houses while the interior of the quarters is being disinfected.[1]

See page 35 for directions for cleaning a poultry house.

[1] This should not result in serious overcrowding at this season of the year, when fewer hens are laying heavily.

4. Removing and disposing of sick and dead birds, feathers, and dressing waste

The successful poultry keeper will observe his birds daily for any evidence of disease or lowered vitality. The latter is sometimes more easily seen than the former, and may reveal something wrong with the general management.

FIG. 121. A small portable sprayer and material and utensils for mixing. *A*, Can of disinfectant; *B*, measuring cup; *C*, pail for mixing; *D*, funnel used in filling sprayer; *E*, sprayer. Note the pump *F* for obtaining air pressure.

Whenever one or more individuals are observed to be in poor condition, immediately remove them from the flock and kill them or keep them in a separate building until the trouble can be diagnosed. Prompt removal may prevent the spread of a disease which otherwise might have proved disastrous. Whenever a bird is found dead, it should be disposed of immediately. Never allow dead birds to lie about the plant, and never throw them upon the manure pile or bury them in it. Each of these alternatives is a dangerous practice.

A. The crematory. One means of disposal is to burn dead birds in a crematory. Such a structure may be used the year round.

A satisfactory crematory consists of a firebox of concrete, the inside measurement of which is approximately 2 by $1\frac{1}{2}$ by $1\frac{1}{3}$ feet. Leave a hole in front for building a fire, and lay iron bars across the top of the firebox for a grate on which the dead birds may be placed.

An incinerating chamber of concrete or galvanized iron, about $1\frac{1}{2}$ feet high, should be built to rest on the firebox. The edges should be tight. At the upper rear of the chamber, leave a pipe hole. Place the dead bird on the iron grate and close the incinerating chamber. Start a fire and maintain it until the carcass is reduced to ashes. It is excellent when carcasses

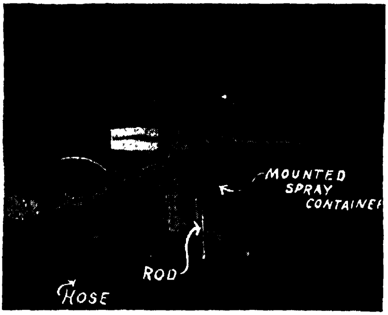


FIG. 122. A spraying apparatus which may be used for disinfecting. Any outfit which includes the features of this one is desirable. Note the pump for applying pressure and the hose and rod, which permit all parts of the house to be reached. A thorough job is essential.

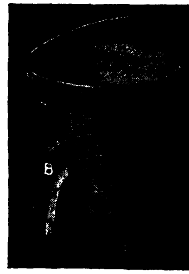


FIG. 123. These utensils will be found useful for cleaning around the water receptacles, mash hoppers, etc. *A*, Pail of disinfectant; *B*, scrub brush; *C*, scraper.

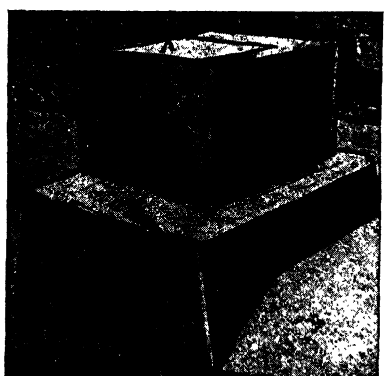


FIG. 124. A crematory. From Maine Agricultural Experiment Station.

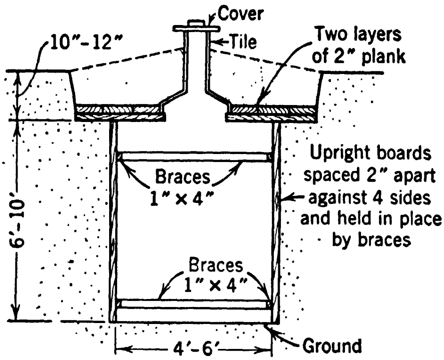


FIG. 125. Cross section of a disposal pit.

FIG. 126. Dropping a dead bird in the disposal pit. A quick and efficient method of handling a common problem on the poultry farm.

are completely burned. Frequently charred bodies accumulate, attracting numerous flies and causing odors. On large plants fires may be needed with much regularity and expense in the use of fuel and labor.

B. The disposal pit requires labor to construct but none afterward except occasional trips to it with dead material. It may be located conveniently. A pit 4 by 5 by 6 feet deep should care for a 1000-hen plant for 2 or more years. It can be constructed deeper, wider, and longer if desired, using more than one hole for dropping refuse. To prevent sides caving in, board or plank supports are placed against the walls.

Provide a ground rest for the top planking which must be stout to prevent collapsing and provide an entrance hole. When the pit is full the top can be transferred to another pit and the old one covered with earth.

GENERAL INFORMATION

Spray materials for disinfection and disease prevention [1]

The "phenol coefficient," which is usually given on the container, is an index of the efficiency of coal-tar products.[2]

The coefficient of any disinfectant indicates its germ-killing strength as compared with a 2½ to 3 per cent carbolic acid solution.[3] The higher the coefficient of a disinfectant, the more water can be added to make a solution of definite germ-killing strength and, therefore, the farther it will go. A disinfectant having a coefficient of 3 has three times the strength of a disinfectant having a coefficient of 1. It will, therefore, when mixed with water, make three times the amount of disinfectant of equal strength.

[1] Spraying or painting for vermin eradication and prevention is discussed in Chapter XII.

[2] J. R. Beach and S. B. Freeborn, Circular 251, University of California.

[3] A 2½ to 3 per cent solution of carbolic acid is strong enough to kill the average disease germ.

Cresol is one of the best general disinfectants for farm use.[1] The commercial cresol is derived from coal-tar and depends upon the amount of cresylic acid for its efficiency. Most of the cresol disinfectants sold are used in 3 or 5 per cent solutions. The manufacturer specifies the strength, and this specification should be followed in its use.

To make:

1% disinfectant solution, add ½ part disinfectant to 5 gallons water
2% disinfectant solution, add 1 part disinfectant to 5 gallons water
3% disinfectant solution, add 1⅕ parts disinfectant to 5 gallons water
4% disinfectant solution, add 1½ parts disinfectant to 5 gallons water
5% disinfectant solution, add 2 parts disinfectant to 5 gallons water

COMMUNITY SURVEY

1. How often is the litter renewed during the year? Is "built-up" litter used?
2. How often are the droppings removed in summer? In winter?
3. What do the poultrymen use on the droppings boards as an absorbent?
4. Make a list of the disinfectants and sprays that are used by local poultrymen.
   (*a*) For what purpose is each used?
   (*b*) How is each used? (As a spray, spread by brush, etc.)
   (*c*) How often is each applied?
   (*d*) What is the cost of each?
   Arrange the disinfectants and sprays in tabular form, under different headings as: cost, ease of application, efficiency, etc., and in order—best to poorest. Study the table and write your conclusions.
5. What percentage of the laying flocks in your community is given range? Breeding flocks? Rearing flocks?
6. What are the poultrymen's reasons for and against range?
7. What types of soils are common in your neighborhood?
8. How do poultrymen dispose of their dead birds?
9. What percentage of the poultrymen burn, bury, or use a disposal pit for their dead birds?
10. Give reasons for their preference.

[1] E. L. Brunett, N. Y. S. Veterinary College, from "Disinfection of Poultry Houses," Cornell University.

11. In your judgment which kind of crematory or incinerator works best? How do you rate the disposal pit and why?
12. Ask for a detailed estimate of the cost of a crematory and a pit, if in use.

REFERENCE

ROBERTSON, E. I., "A Poultry Disposal Pit," Cornell Extension Bulletin 663, 1944.

CHAPTER XIV

PREPARING EGGS FOR MARKET[1]

The poultryman has a peculiar advantage, as compared with the producer of milk, for example, in that the hen delivers her product in such convenient form. She gives him the semi-fluid, edible portion of the egg, in a convenient size for table use, in a special sealed package, wrapped with two shell membranes, and sealed within the egg shell.

All the skill, expense, hazard, and thought given to the enterprise culminate in the production of the egg. The aim, therefore, should be to preserve the quality of the finished product and thereby secure a proper price.

Operations:

1. Producing clean eggs.
2. Gathering the eggs.
3. Holding market eggs.
4. Cleaning market eggs.
5. Sorting market eggs.
6. Candling market eggs.
7. Standards for quality of individual shell eggs.
8. Packing eggs for shipment.
9. Studying a fresh egg.
10. Detecting abnormal eggs.

[1] For a discussion of distributors, methods of marketing, and the operation of cooperatives, auctions, and other receivers, the reader is referred to *Marketing Poultry Products,* fourth edition, by Benjamin, Pierce, and Termohlen, published by John Wiley & Sons.

General information:

1. Why eggs lose quality.
2. Factors affecting the interior quality of eggs.
3. The standard 30-dozen case.
4. Home preservation of eggs.

Correct care should be given the eggs before and during shipment in order that they may be as near the original quality as possible upon arrival at the market.

1. Producing clean eggs

Dirty eggs are an expense to someone. Washing them takes time. If they are shipped dirty to market, they will bring a smaller price than clean eggs of the same size.

Reduce the numbers of dirty eggs by observing these rules:

(1) Construct the nests 7 to 8 inches deep inside and allow another 7 inches from the top of the front board to the ceiling (Figs. 43 and 46).

(2) Provide 4 to 5 inches of fine, clean, fluffy, and absorbent nesting material, such as shavings, oat, buckwheat, or peanut hulls.

(3) Keep the nest material clean and remove any that is dirtied by broken eggs or manure.

(4) Do not let the birds roost on the nests at night.

(5) Allow 1 foot of nesting space for each 5 or 6 hens to avoid undue crowding and egg breakage.

(6) Keep the litter clean and dry. (See page 269.)

(7) Do not let storms drive into the house.

(8) Avoid overcrowding. Allow 3 square feet of floor space, or more, to each bird.

(9) Clean up and prevent wet places near the water dishes. (See page 68.)

2. Gathering the eggs

Use strong pails of woven or welded wire or those with sides perforated with ½- or ¾-inch holes (Fig. 127). Eggs may be

left in the pail to cool or spread on raised wire trays. Pails with flexible sides will crack the eggs and should be avoided.

Baskets, if strong, are satisfactory, but they should be openly constructed. They permit cooling.

Collect eggs three or four times daily. During very warm

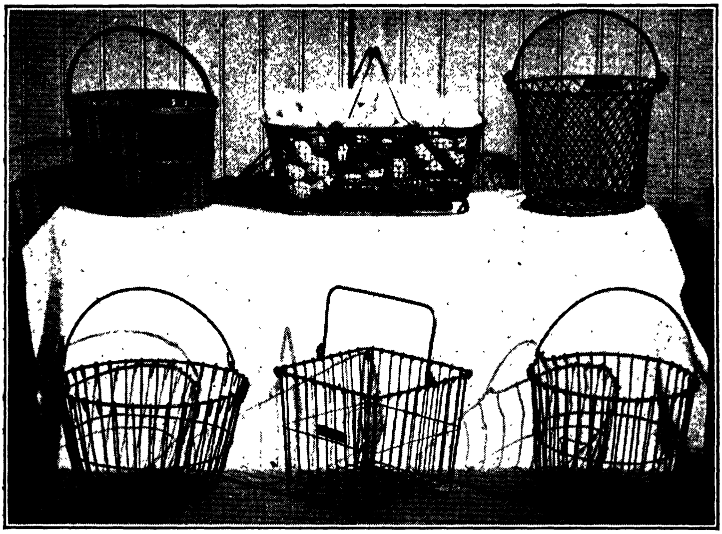


FIG. 127. Types of baskets used for gathering eggs.

or very cold weather, and when the birds are laying heavily, collect at 8:30 to 9:00, 10:30 to 11:30, 2:30, and at night, to prevent the eggs from becoming heated, frozen, broken, or dirty.

Eggs should be cooled quickly after they are laid. They contain a beneficial gas (carbon dioxide) that helps to maintain quality. This gas is lost more easily at room temperatures or above; hence, cooling eggs retards the loss of CO_2, but hastens the heat loss, both of which are apparently beneficial to eggs.

3. Holding market eggs

Take the eggs at once to a clean cellar or room, which is free from any musty odor. Do not leave pails in the kitchen, pantry, or other room until the dirties are sorted out. A uni-

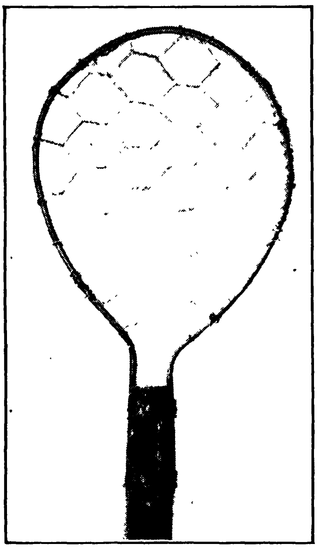


FIG. 128. A handy homemade device for getting eggs from out-of-the-way places.

FIG. 129. Side view of the egg-retrieving device. Note the bulge in the wire.

form temperature between 45 and 60 degrees F., good ventilation, and 75 to 80 per cent relative humidity are desirable. *Eggs, like milk, lose quality rapidly under poor holding conditions. Cooling and high humidity retard deterioration; warmth or jarring hastens it.* Eggs should cool for 12 hours in the pails before being packed in the cases. Today's eggs should be packed tomorrow. The cases should have been in

the cellar and, therefore, cool. Quickly cooled eggs, packed in a cool case and held in a cool, moist cellar until they are shipped, should reach the market in excellent condition. The fillers and flats hold the cold in but keep circulating air out, which is desirable.

Egg rooms

Still-air cooling occurs best in a room built underground and which has a room or building above. An earth floor allows the soil moisture to enter the room. Water may be added to the floor, if needed. Such a room should have outside walls of stone or concrete with insulated walls separating it from the main cellar. It should be placed on the north or northeast side of the cellar and have at least one window near the ceiling which may be used for ventilation. A slatted rack on the floor will keep the baskets and cases off of the ground.

Shrubbery or trees which protect the building will assist the egg room in its functioning.

Circulating-air cooling is more rapid and can be satisfactorily used when electricity is available. See Figs. 131 and 132.)

Excessive use of the fan should be avoided due to possible evaporation of the eggs. One and one-half to 3 hours is usually sufficient to cool a given lot of eggs as in Fig. 132, while ¾ to 1½ hours should suffice in an arrangement such as that shown in Fig. 131.

For cooling large numbers of eggs or a large room area, in the absence of special cooling equipment, much good has resulted by hanging sheets of burlap on four sides and keeping the burlap wet by water dripping from small holes in pipes placed just above it. A large fan causes faster evaporation from the burlap and reduces the temperature inside the room.

Size of Egg Room. Each 52 eggs produced daily means 1 case to ship weekly. For a flock of 2000 to 2500 layers, provide a room approximately 12 to 15 feet long by 8 to 10 feet wide for the cool room where eggs will be held in pails and

FIG. 130. A desirable egg cellar on a small poultry farm. The concrete walls against the outside bank of earth, the dirt floor, the window (upper right) for ventilation, a building above, and shade trees, help keep the room cool and moist.

FIG. 131. Circulating air is used to cool eggs quickly in this egg room. An electric fan in the end at *A* drives air into the wooden chute, through holes in the top, and into and through the wire-bottomed pails. A fine mist of water is sprayed constantly into the room, maintaining a relative humidity of 85 to 90 per cent. Excellent quality eggs reach the market from this farm.

in crates and where at least 1 week's supply of empty crates, flats, and fillers may be stored. A second room of similar size is needed for washing and sizing machines and for packing.

FIG. 132. This 10′ × 20′ egg cellar is built into a bank of earth. The ceiling is insulated with several inches of shavings. An electric fan in a movable box blows air against the pipes which contain cold, running water. Water drips over the burlap at the left.

4. Cleaning market eggs

Slightly dirty eggs may be cleaned with a sandpaper cleaner. Very dirty eggs may be held under warm (140–165 degrees F.), running, tap water while they are being washed. *Do not leave* the dirty eggs in a pail or pan of water as they absorb both water and bacteria.

Work by Funk[1] indicates that "soiled eggs cleaned with NaOH solution kept equally as well in cold storage as clean eggs which were not washed."

One per cent of concentrated lye (NaOH) added to clear water appeared to destroy surface bacteria and any just inside the shell. Rubber gloves should be used when washing eggs in this solution. "The water containing sodium hydroxide used

[1] E. M. Funk, "Improving the Keeping Quality of Eggs by Cleaning with Sodium Hydroxide," Research Bulletin 277, University of Missouri, February, 1938.

in washing eggs should be changed often so that the eggs washed are thoroughly cleaned of all contamination."

How dirt and washing may affect interior quality. When the egg comes in contact with wet manure or other moist dirt, damaging bacteria or mold spores, if present, may pass through the shell pores to the inside of the egg. Washing will remove the dirt from the surface but not the bacteria from inside the shell.

Washing in warm water causes the egg contents to expand, thus preventing other bacteria from entering during the washing process. It may also destroy some of the bacteria already inside the shell.

Washing in cold water has the opposite effect and should be avoided.

Egg-washing machines are becoming available (Fig. 134*A*, *B*).

Effort should be made to produce clean-shelled eggs, and to establish a reputation in the market to that effect. Such efforts are likely to be amply repaid.

5. Sorting market eggs

If the eggs are to be shipped direct to distant consumers or to a dealer who pays on a quality basis, they must be well packed, and it may be necessary to sort them for size, shape, color, and shell condition. The operation of sorting and candling the number of eggs produced on a small plant or farm may be done at one handling and with a small egg scale near by. Machines which sort automatically into several sizes are used on poultry farms of several hundred hens (Fig. 134*C*).

A case should be filled with eggs of the same size. If eggs in a single case are of different sizes, pack each size in a separate filler, lay a card on top of the filler denoting number and size, and record also on the outside of the crate.

A. Size. (Figs. 136, 137, 138.) The size of market eggs is usually determined by weight per individual egg, per dozen, or per 30-dozen crate. The size is often estimated by the eye as

the eggs are handled, and then checked by weighing a dozen or a case to determine the actual weight.

Market eggs vary in size from about 1¼ to 2½ ounces each. Smaller or larger eggs than these are usually not marketed.

Eggs are sorted into large, medium, and small. The following weights are used in several markets.

U. S. WEIGHT CLASSES FOR CONSUMER GRADES FOR SHELL EGGS

Suggested August 1, 1947

Size or weight class	Minimum net weight per dozen (ounces)	Minimum net weight per 30 dozen (pounds)	Minimum weight * for individual eggs at rate per dozen (ounces)
Jumbo	30	56	29
Extra large	27	50½	26
Large	24	45	23
Medium	21	39½	20
Small	18	34	17

* Minimum weights listed for individual eggs at the rate per dozen are permitted in various size classes only to the extent that they will not reduce the net weight per dozen below the required minimum with thorough consideration given to variable weight of individual eggs and variable efficiency of graders and scales which should be maintained on a uniform and accurate basis.

B. Shape. Long or wide eggs should be eliminated from a shipment or packed in the center of the top filler. It may be necessary to build up the ends of the case with ¼- to ⅜-inch strips before nailing on the top to prevent breakage. Slight bulges, creases, or moderate roughness in the shell are not sufficient to exclude eggs from a grade (Fig. 140).

C. Color. Certain markets prefer white-shelled eggs; others prefer brown. It is well to cater to these preferences, although shell color has little to do with the interior quality of eggs.

D. Shell condition. Thin- or very rough-shelled eggs may break easily in shipment. It is better to sell them locally or use.

E. Checks or leakers.[1] Bakeries will often use these eggs, but it is better to use small supplies of them at home or dispose of them to local consumers rather than attempt to ship them.

A leaker is an egg cracked so that the contents leak out.

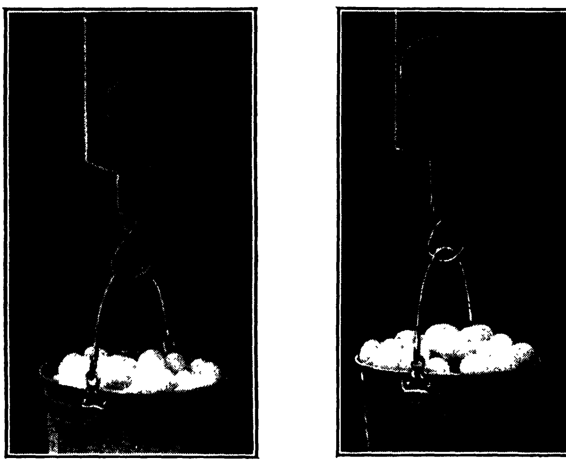


FIG. 133. Note difference in weight. The same pail and scales and an equal number of eggs. *Left:* These eggs averaged 1.96+ ounces each, 23.5 ounces per dozen, or 44.25 pounds net per case. *Right:* These eggs averaged 2.2+ ounces each, 26.4 ounces per dozen, or 49.75 pounds net per case. A difference of 5.5 pounds of eggs per case. This amounts to the equivalent of 3¼ dozen more eggs.

6. Candling market eggs

Candling market eggs is a study of lights and shadows. By candling, the interior quality of eggs is determined. To candle an egg is to hold it in front of a light shining through an opening and into the egg. Most candling is done in a darkened room. The egg is held large end up and at a 45-degree angle (Fig. 137). Both air cell and yolk shadow can then be seen. The position of the yolk is determined by

[1] The best preventive is deep, clean nest material and careful handling.

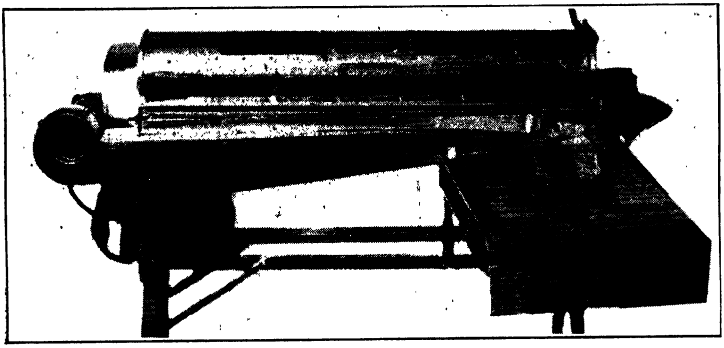


Fig. 134*A*.

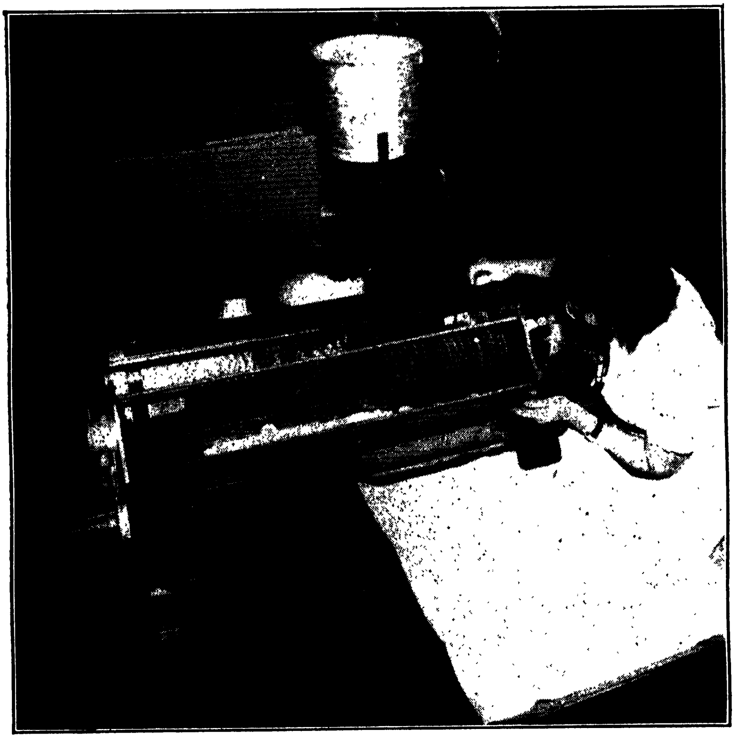


Fig. 134*B*.

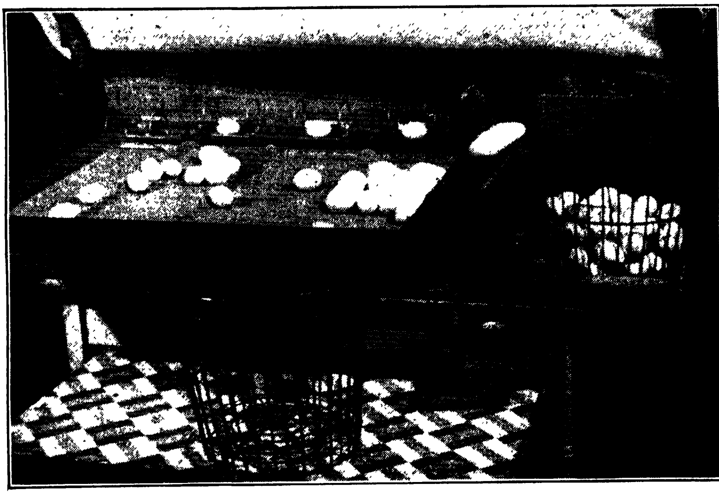


FIG. 134C.

FIG. 134. Machines for cleaning and sizing eggs. *A*. Egg washing machine for cleaning 4 or 5 cases of eggs per hour. Courtesy Dr. F. B. Wright, Cornell Univ. *B*. The machine with top lifted to show cleaning discs. Eggs enter at right, proceed to the left on the far side where the revolving flexible discs, wet with water at 165° F., wash the eggs which return on this side, pass over blotting cloth, and then are dried by warm air. The eggs leave the machine through the chute below the guard. Courtesy Dr. F. B. Wright, Cornell Univ. *C*. Egg-sizing machine. Eggs are moved along until they tip the scale on which they are deposited.

examining before and after the contents are set whirling by a quick turn of the wrist.

Use a 40-watt light or a 60-watt light. A convenient bench under the candling apparatus facilitates the rapid handling of eggs.

Many satisfactory candling devices are available on the market, but a tinsmith can make one (Fig. 138).

Whether candling should be done by a producer depends upon his outlet. It is best to candle for a high-class retail trade and remove any with poor interior quality.

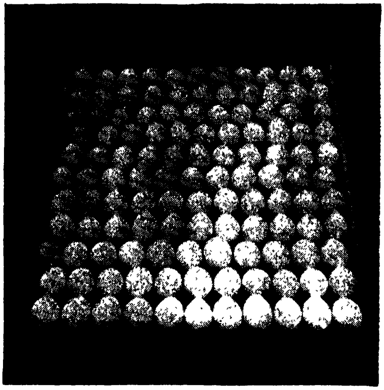


FIG. 135. From the heavier pail in Fig. 133. Note large size and consequent uneven placing on the tray. Compare with the tray in Fig. 136, containing the same number of eggs from the pail shown in Fig. 133.

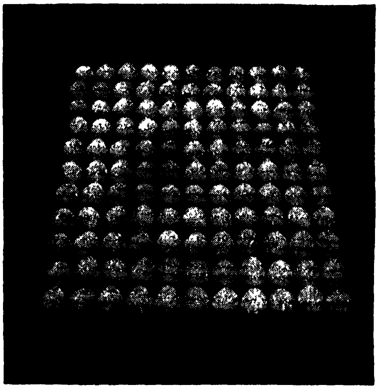


FIG. 136. From the pail at the left in Fig. 133. Note the tray space not used.

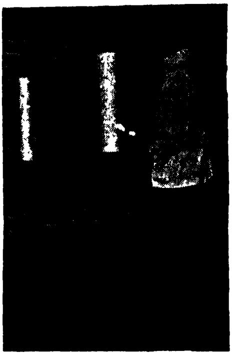


FIG. 137. Candling eggs. Note the position of the egg, the pail in which eggs are gathered, and the case for the candled eggs.

FIG. 138. A candling device that can be slipped on to the center partition of an egg case or piece of similar size. Two persons can work on opposite sides.

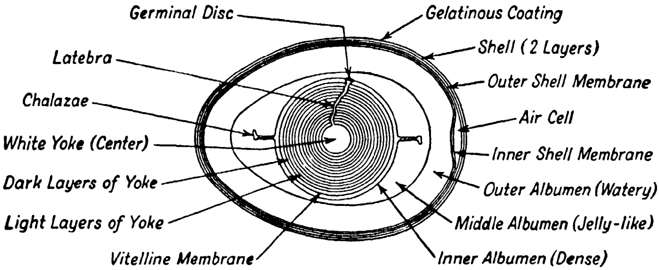


FIG. 139. Cross section of an egg. A fourth inner thin layer of albumen is enclosed within the middle (jelly-like) layer.

All eggs passing through ordinary marketing channels are candled somewhere before retailing to the consumer.

7. Standards for quality of individual shell eggs

Quality standards describe the condition of individual eggs; grades describe the combinations of those eggs in any given lot. The quality standard of eggs must be determined before a grade can be placed.

The quality of an egg changes gradually as it proceeds from the finest, when first laid, toward an inedible condition. The U. S. standards divide these quality changes into four main interior quality conditions—AA, A, B, C, and four exterior quality conditions, Stained, Dirty, Check, and Leaker. Any edible egg is one or the other of these standards for quality.

Grades tell the minimum number of these various eggs which comprise a dozen, case, or car. Included in the grade is the *tolerance* which is the number of eggs of varying qualities permitted in any lot of a single grade.

Specifications for Official United States Standards for Quality of Individual Shell Eggs

Effective December 1, 1946

U. S. standards for quality of individual eggs with clean unbroken shells:

AA Quality. The shell must be clean, unbroken, and practically normal. The air cell must not exceed 1/8 inch in depth and be practically regular. The white must be clear and firm so that the yolk appears well centered and its outline only slightly defined when the egg is twirled before the candling light. The yolk must be free from apparent defects.

A Quality. The shell must be clean, unbroken, and practically normal. The air cell must not exceed 2/8 inch in depth and must be practically regular. The white must be clear and at least reasonably firm so that the yolk appears at least fairly well centered and its outline only fairly well defined when the egg is twirled before the candling light. The yolk must be practically free from apparent defects.

B Quality. The shell must be clean, unbroken and may be slightly abnormal. The air cell must not exceed 3/8 inch in depth and may show total movement not in excess of 3/8 inch. However, an air cell not over

⅜ inch in depth may be free. The white must be clear but may be slightly weak so that the yolk may appear off center with its outline well defined when the egg is twirled before the candling light. The yolk may appear slightly enlarged and slightly flattened and may show other definite but not serious defects.

C Quality. The shell must be clean, unbroken, and may be abnormal. The air cell may be over ⅜ inch in depth and may be bubbly or free. The white may be weak and watery so that the yolk may appear off center and its outline plainly visible when the egg is twirled before the candling light. The yolk may appear dark, enlarged, and flattened and may show clearly visible germ development but no blood due to such development. It may show other serious defects that do not render the egg inedible. Small blood clots or spots may be present.

U. S. standards for quality of individual eggs with dirty unbroken shells:

Stained. Individual egg that has no adhering dirt and no more than a combined total of ⅛ of the shell surface stained or soiled.

Dirty. Individual egg that has adhering dirt or more than a combined total of ⅛ of the shell surface stained or soiled.

U. S. standards for quality of individual eggs with checked or cracked shells:

Check. Individual egg that has a broken shell or crack in the shell but with no leakage of the contents.

Leaker. Individual egg that has a broken shell or crack in the shell and shell membranes with the contents exuding or free to exude through the shell.

EXPLANATION OF TERMS

The Official United States Standards for Quality of Individual Shell Eggs are applicable to eggs that are the product of the domesticated chicken hen and are in the shell.

A. Terms descriptive of shell

Clean. A shell that is free from foreign matter and from stains or discolorations that are readily visible. Eggs with only very small specks or stains may be considered clean, if such eggs are not of sufficient number in a package to detract appreciably from its appearance. Eggs that show traces of processing oil on the shell are considered clean unless the shell is otherwise soiled.

Stained. A shell with stained or soiled spots that together cover not more than ⅛ of the shell surface but without adhering dirt.

Dirty. A shell with adhering dirt or with stained or soiled spots that together cover more than ⅛ of the shell surface.

Unbroken. A shell that is free from checks or breaks.

Checked or cracked. A shell that has an actual break but its membranes are unbroken and its contents do not leak.

Leaker. A leaker is an egg in which the shell and shell membranes are broken to the extent that the egg contents are exuding or free to exude through the shell.

Practically Normal (AA) (A). A shell that approximates the usual shape and that is of good even texture and strength and free from rough areas or thin spots. Slight ridges and rough areas that do not materially affect the shape, texture and strength of the shell, are permitted.

Slightly Abnormal (B). A shell that may be somewhat unusual in shape or that may be slightly faulty in texture or strength. It may show definite ridges but no pronounced thin spots or rough areas.

Abnormal (C). A shell that may be decidedly misshapen or faulty in texture or strength or that may show pronounced ridges, thin spots, or rough areas.

B. Terms descriptive of the air cell

Depth of air cell (air space between shell membranes, normally in the large end of the egg). The depth of the air cell is the distance from its top to its bottom when the egg is held air cell upward.

Practically regular (AA) (A). An air cell that maintains a practically fixed position in the egg and shows a fairly even outline, with no more than ⅛ inch movement in any direction as the egg is rotated.

Movement not in excess of ⅜ inch (B). An air cell that shows a total movement not in excess of ⅜ inch in any direction as the egg is rotated.

Free air cell (B) (C). An air cell that moves freely toward the uppermost point in the egg as the egg is rotated slowly.

Bubbly air cell (C). A ruptured air cell resulting in one or more small separate air bubbles usually floating beneath the main air cell.

C. Terms descriptive of the white

Clear (AA) (A) (B). A white that is free from discoloration or from any foreign bodies floating in it. (Prominent chalazas should not be confused with foreign bodies such as spots or blood clots.)

Firm (AA). A white that is sufficiently thick or viscous to permit but limited movement of the yolk from the center of the egg, thus preventing the yolk outline from being more than slightly defined or indistinctly indicated when the egg is twirled.

Reasonably firm (A). A white that is somewhat less thick or viscous than a firm white. A reasonably firm white permits the yolk to move somewhat more freely from its normal position in the center of the egg and approach the shell more closely. This would result in a fairly well defined yolk outline when the egg is twirled.

Slightly weak (B). A white that is lacking in thickness or viscosity to an extent that it permits the yolk to move quite freely from its normal position in the center of the egg. A slightly weak white will cause the yolk outline to appear well defined when the egg is twirled.

Weak and watery (C). A white that is thin and generally lacking in viscosity. A weak and watery white permits the yolk to move freely from the center of the egg and to approach the shell closely, thus causing the yolk outline to appear plainly visible and dark when the egg is twirled.

Blood clots and spots (not due to germ development). Blood clots or spots on the surface of the yolk or floating in the white. These blood clots may have lost their characteristic red color and appear as small spots or foreign material, commonly referred to as meat, during formation or after the yolk leaves the ovary. If they are small (not over ⅛ inch in diameter) the egg may be classed as C quality. If larger and/or showing diffusion of blood in the white surrounding them, the egg shall be classified as loss.

Bloody white (loss). An egg, the white of which has blood diffused through it. Such a condition may be present in new-laid eggs. Eggs with bloody whites are classed as loss.

D. Terms descriptive of yolk

Well centered (AA). A yolk that occupies the center of the egg and moves only slightly from that position as the egg is twirled.

Fairly well centered (A). A yolk that is not more than one-fourth of the distance from its normal central position toward the ends of the egg and swings not more than one-half of the distance from its normal position towards the sides of the egg as it is twirled.

Off center (B) (C). A yolk which is distinctly above or below center and swings close to the sides of the egg as it is twirled.

Outline slightly defined (AA). A yolk outline that is indistinctly indicated and appears to blend into the surrounding white as the egg is twirled.

Outline fairly well defined (A). A yolk outline that is discernible but not clearly outlined as the egg is twirled.

Outline well defined (B). A yolk outline that is quite definite and distinct as the egg is twirled.

Outline plainly visible (C). A yolk outline that is clearly visible as a dark shadow when the egg is twirled.

Fig. 140. A contrast in sizes and shapes of eggs. The perfect-shaped egg should fill without crowding either at the top or the side of the carton when packed, little end down. The 30 eggs shown here illustrate the extent of injury which might take place from crushing when placed in the container. The opening in which each egg is placed is the same size as that in a standard 3-dozen egg-case filler, namely, 2¼″ by 1¾″. The black portion surrounding the egg shows the space in the filler unused by the egg.

Fig. 140—Continued.

A. Fills the space completely with slight pressure from the cushion or flat above. Too large for safe shipment without adding to the height of the crate.

B. Slightly smaller and provides a little latitude for movement which allows the egg to tilt slightly in the carton. This permits a longer egg to be placed in the carton than would be the case if the egg stood perpendicular. This is a desirable size and shape for the fanciest egg trade.

C. Slightly wide, which makes it more difficult to tip the egg diagonally in the container. It exactly fills the carton without danger of side crushing. (A safe type to ship.)

D. Excessively long, making it impossible to ship in any position in the container without crushing from above.

E. Too large for the container and is subject to crushing both from the side and the top. Such eggs could only be shipped in crates higher than the standard, which would permit the liberal use of cushions above and below to absorb the shock.

F. Correct in width but too long to be used in the standard-sized carton. Such eggs may be packed in the corner containers of 3-dozen egg fillers.

G. Abnormal in shape, being somewhat cylindrical and too narrow in proportion to its length. Could be shipped by placing diagonally in the container.

H. An elliptical type of egg of large size, difficult to pack safely without special cushions above.

I. A fairly large egg, filling the container, with slight latitude for motion. A desirable type, but not equal, however, to *A*, *B*, or *C*.

J. A very large egg, filling the carton completely at the sides and requiring a cushion and flat to prevent top crushing.

K. About equal to *J* as to desirability in shipping.

L. An exceedingly symmetrical type of egg, but must be packed as in the case of *F*, *G*, *H*, *J*, and *K*.

1. A very blunt elliptical type, desirable from a display or shipping standpoint. Such eggs weigh heavier than they look when viewed from the side and show to the greatest advantage when viewed from above as in *A*, *B*, *C*, *E*, which is the position of eggs when placed on sale in the cartons.

M. Not only too long but abnormal in shape. Should not be used for hatching purposes and ordinarily should not be placed in a top grade.

N. Has the same faults as *D*.

O. An abnormally long, narrow egg. Could not be shipped successfully and must be used for home consumption. Such eggs should never be incubated.

P and *Q*. Two of a great variety of abnormal types. The birds which laid these eggs might or might not again lay eggs of similar shape.

2. Similar in shape to Nos. 1 and 3 but weighing 2 oz. more per doz. All three are desirable types.

4. A very large egg, of splendid shape, which requires special care in packing in oversized containers but which would command the highest price on exterior appearance.

5. Quite similar to No. 2 as to size and weight.

6. Similar to No. 3 and exactly meeting the minimum requirements as to weight and fully meeting the requirements as to shape for a fancy pack.

7. Similar to Nos. 2 and 3 in shape, but weighing 1 oz. less than the former and 1 oz. more than the latter.

8, 9, and 11. Three other desirable types, weighing from 24 to 26 oz., a desirable weight for securing the top price.

10. A 30-oz. egg having no fault except oversize and like *J*, *K*, and *L* requires oversize fillers or cushions and crates.

12. Exceedingly desirable type, slightly oversize, requiring special care in packing.

13. A 25-oz. egg, exceedingly deceptive in its weight. It looks when viewed from the side to be larger than No. 7, just above, the difference being due to the fact that No. 7 is wider both near the large and the small end.

Slightly enlarged and slightly flattened (B). A yolk in which the yolk membranes and tissues have weakened somewhat causing it to appear slightly enlarged and slightly flattened.

Enlarged and flattened (C). A yolk in which the yolk membranes and tissues have weakened and moisture has been absorbed from the white to such an extent that it appears definitely enlarged and flat.

Free from defects (AA). A yolk that shows no spot or areas on its surface indicating the presence of germ development or other defects.

Practically free from defects (A). A yolk that shows no germ development but may show other very slight defects on its surface.

Definite but not serious defects (B). A yolk that may show definite spots or areas on its surface but with only slight indication of germ development or other pronounced or serious defects.

Other serious defects (C). A yolk that shows well developed spots or areas and other serious defects, such as olive yolks, which do not render the egg inedible.

Clearly visible germ development (C). A development of the germ spot on the yolk of a fertile egg that has progressed to a point where it is plainly visible as a definite circular area or spot with no blood in evidence.

Blood due to germ development (inedible). Blood caused by development of the germ in a fertile egg to the point where it is visible as definite lines or blood ring. Such eggs are classified as inedible.

E. General Terms

Loss. Eggs that are inedible, smashed, broken so that contents are leaking, contaminated, or containing bloody whites, large blood spots, large unsightly meat spots, or other foreign material are classed as "Loss."

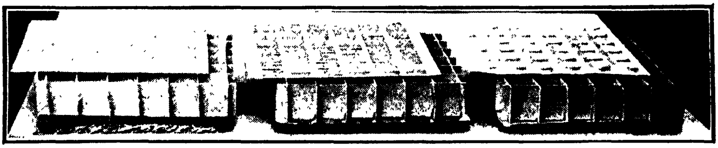
Inedible eggs. Under the Food, Drug, and Cosmetic Act, eggs that are filthy, putrid, or decomposed, or otherwise unfit for food in whole or in part, are adulterated. Eggs of the following descriptions are classed as inedible: black rots, white rots, mixed rots (addled eggs), sour eggs, eggs with green whites, eggs with stuck yolks, moldy eggs, musty eggs, eggs showing blood rings, eggs containing embryo chicks (at or beyond the blood ring stage), and any other eggs that are filthy, decomposed, or putrid.

8. Packing eggs for shipment

If eggs are to be sold locally at retail, they may be delivered in pails, baskets, or cartons holding one dozen each. The carton is usually best, as it holds the eggs securely and adds to the attractiveness and convenience of the package. The cost

of the carton and the extra labor are important items, but eggs so packed usually find customers who are willing to pay the extra cost for having them delivered in a convenient container (Fig. 144).

FIG. 141. An egg-grading and packing room. A commercial grader is being used on this plant where 2000 to 4000 eggs per day are prepared for market.



1 2 3

FIG. 142. Types of flats used in packing eggs. 1. Straw board, flat, and excelsior pad. (Excelsior pads are thin pads of excelsior held together by a paper wrapper. They should weigh from 3 to 4 oz. each. They are evenly made and are much better than loose excelsior.) 2. Corrugated flat. 3. Cup flat used both as flat and when two are placed back to back, as pad.

For shipping to outside points, the standard 30-dozen case is best.

When packing eggs, one should see that the top layer is typical of the whole package. Eggs should be packed with the large end up because the air cells will be better preserved and the eggs present a better appearance.

In packing the 30-dozen case, the following method gives a

minimum amount of breakage. Breakage is usually greatest near the top.[1]

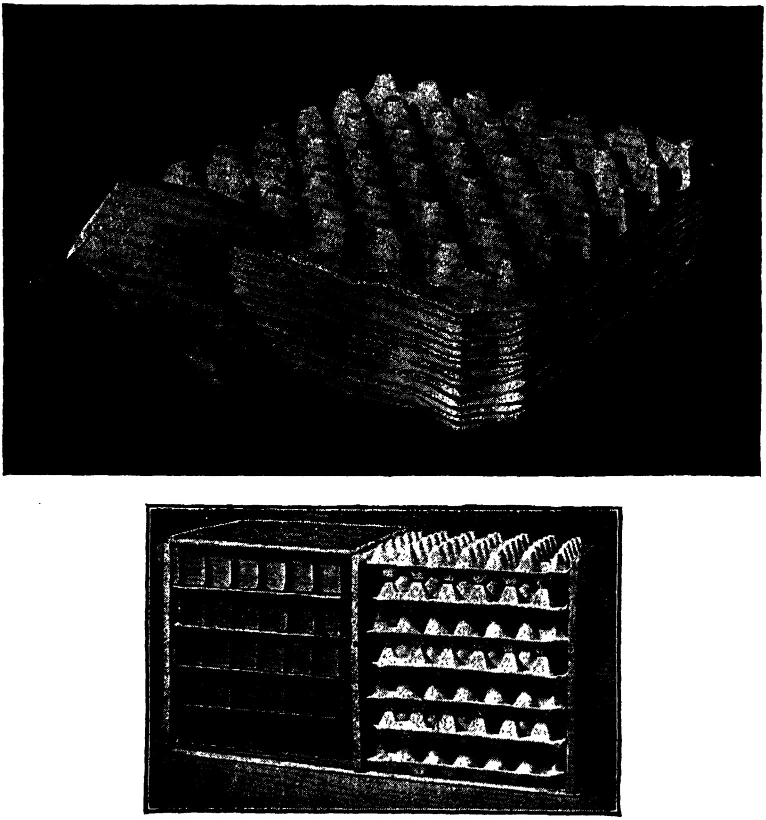


FIG. 143. Keyes filler. Combines in a single piece both flat and filler. Courtesy of Keyes Fibre Company, Inc., 30 Church Street, New York City.

Packing with cup flats. Place one flat on the bottom, cups up. Then alternate filler and flat to the top of the case. Place

[1] Examination of a filler will show each individual strip to be slit half-way across. Each egg space, therefore, is bounded on opposite

one flat on top of the pack, cups down. The top is laid on and nailed with four nails in each end. Never nail the top in the center. The cup flat is gaining constantly in favor. It reduces breakage to a minimum and prevents the contents of a broken egg from soiling other eggs in the same filler.[1]

FIG. 144. Types of egg cartons (1-dozen size).

9. Studying a fresh egg

As a fresh, white-shelled egg is held before the candle, the egg as a whole appears pinkish yellow. Looking closely at the upper end, one can see the air space, about the diameter of a ten-cent piece, or smaller. The yolk also appears as a diffused shadow at about the center of the egg. A dark spot usually follows or precedes the yolk as it turns around after the egg is twirled. This spot is one of the chalazae. It is sometimes confused with a meat spot. The shell membranes are firm around the air space.

sides by a strip of filler which has been slit on either side, thus making this section weak in half of its width. The other two sides have the strong uncut half at the top and are therefore better able to hold the eggs firmly. Fillers should be placed in the crate with the uncut half at the top and crosswise of the case, as most strain and greatest breakage occur through the end movement.

[1] Many market men like to remove a layer or two of eggs to examine the pack below. In so doing, the hand is pushed down at opposite corners of the filler, between the filler and the case, grasping the filler and flat. The filler, held firmly and bent slightly, is lifted, together with the three dozen eggs it contains. After a little practice, a person may become quite skillful and may transfer an entire case in a short time.

A brown-shelled egg looks similar, but the shell gives the contents a darker color.

Variations from these qualities occur when the egg is kept under unfavorable conditions or for a considerable time. The air cell may be larger or perhaps loosened, the yolk darker and heavier.

10. Detecting abnormal eggs

As the egg is twirled before the candle, abnormalities will occasionally be detected.

A. Blood clot. A blood clot appears as a red spot attached to the yolk. It differs from an embryo as there are no radiating blood vessels. Blood clots are usually caused by the rupture of a blood vessel in the yolk sac, or a follicle which is broken when the sac splits and lets the yolk drop into the oviduct. The clot is deposited on the yolk before the albumen is laid on. (See Chapter XX for the formation of an egg.) Blood-clot eggs seldom should be marketed but may be used at home after the clot has been removed. A small clot does not injure the egg for food.

B. Bloody eggs. Blood in the albumen gives the egg a red tint throughout. Bloody eggs may be caused by the spreading of a blood clot in the albumen, or may be due to a diseased or injured condition of the oviduct, causing blood to be exuded with the egg white when the egg is being formed. The yolk may be used. The white is usually discarded. Such eggs are less common than blood clots.

C. Meat spots. Meat spots appear floating in the egg white, either entirely free or attached to the chalazae. The floating particles vary in size and color. They are usually small blood spots which became dislodged and the red color lost. They may be portions of the walls of the oviduct or abnormal growths of tissue which develop in the oviduct and are later dislodged when an egg passes through. Meat spots may vary from white to dark brown. After the meat spot has been

removed, the egg is suitable for food. Such eggs seldom should be marketed.

D. Double-yolk eggs. Eggs with two yolks are very common and can be detected easily by the two distinct shadows seen while candling, even if the increased size of the egg is not sufficient indication. These eggs are as good as any, but in order to keep the salable product uniform they are generally used at home.

E. Body checks. A healed-over shell cracked in the body.

Many other abnormalities occur, but those mentioned are the most common. It is well to break open eggs which appear unusual in any particular, and become familiar with the cause. This practice aids the candler in detecting a similar case at another time.

GENERAL INFORMATION

1. Why eggs lose quality

The subject of egg quality is one of great interest and is open to considerable controversy. It is generally assumed that the eggs are best when first laid. Certain it is that the individual egg will never be any better or fresher, if we may use that term, than immediately after it is laid.

It is well to keep in mind that eggs when first laid are not always of high quality. In fact, it is not impossible (though of rare occurrence) that hens lay eggs which are inedible. Eggs of all degrees of quality, from the very finest to the inedible, are found immediately after they have been dropped by the hen. The causes of this are several.

Eggs from different hens may vary in quality. One hen may consistently lay A and another B quality eggs. Occasionally, though rarely, a hen may vary in the quality of her eggs because of low vitality either naturally or as a result of feeding or management or other abnormal conditions.

Hens through fear or undue excitement sometimes hold their eggs within their bodies for a considerable length of time.

Because of bacterial infection from the body of the hen, or because the germ in a fertile egg dies, or for other reasons, decomposition may set in. The natural high temperature of a hen's body, 105 to 107 degrees F., hastens the breaking down of the egg if held for long within the body.

An egg may mature and reach a point where it is ready to be laid just after a bird has gone to roost in the evening and be held until the following morning in the body of the bird. Twelve or fourteen hours at that high temperature after the egg is ready to be laid might lower the quality before the hen lays the egg the following day.

Hence it can be said that eggs are not of exceptionally high quality in every instance because they were just laid or because they reached the market a very short time after being produced, because an egg may be well along on its quality journey by the time it is laid. In general, it is correctly assumed that under normal conditions the majority of eggs just laid are of fine quality.

Eggs are perishable. Regardless of the quality when laid, an egg moves rapidly from its original quality toward a still lower quality unless something is done to check it. The rapidity of this movement toward lower quality depends on the environment surrounding the egg.

Because there is no known method for making an egg better in quality once it is laid, and because eggs always move toward lower quality, it follows that our only chance of getting to market eggs as good in quality as when they were produced is to provide conditions which will hold the original quality that the hen put into the egg.

2. Factors affecting the interior quality of eggs

The quality of an egg is influenced by a number of factors, some of which are discussed below.

A. Temperature. The older or more inferior an egg is the more rapidly will it be affected by extremes of temperature. The eggs should be cooled immediately after they are laid.

Temperatures above 60 degrees are responsible for some deterioration in the quality of the egg whether fertile or infertile, but they are especially disastrous to a fertile egg. Warm, dry air causes rapid evaporation, especially if it blows over the eggs. Weak, watery eggs of a stale flavor soon result.

Sharp and Powell, of Cornell, found the temperature and the number of days required to lower the quality of eggs to the same point (about B quality) as follows:

Number of Days	Temperature, Degrees F.
3	98.6
8	77.0
23	60.8
65	44.6
100	37.6

The importance of low temperature is evident. Temperature is of greater importance than age.

High temperatures permit the mucin fibers in the albumen to break down and liquefy and water to pass from the albumen to the yolk, thus increasing its weight and causing the yolk to flatten. A beneficial gas, CO_2, is lost from the egg.

Quick cooling drives the heat out quickly and retards the loss of CO_2.

(1) *The dark-yolk problem.* The dark yolk, as it is called on the eastern market, when eggs are candled, is largely a fallacy brought about by a combination of conditions which have tended to outweigh the facts. Consumers, in general, prefer the yolk color uniform when breaking out several eggs. Whether the color is light, medium, or dark is secondary. The extreme light or extreme dark yolks are less popular with the consumer.

Weak whites may be inherited or result from breaking down under high temperature. Green feed causes dark yolks, as also does heavy yellow corn feeding. Both conditions are found in many eggs produced on general farms. Eggs of low quality or with weak whites have a more visible yolk shadow and mobile yolk. Therefore, when a low-quality egg which

shows considerable yolk shadow is broken, a dark yolk is often found.

A strong-bodied egg has a dimly visible yolk shadow and is considered to have a light yolk, although, upon breaking, it may be found dark. What the dealer sees is the yolk shadow and not the color of the yolk.

A dealer rather than a consumer prejudice against the dark yolk has thus been built up.

Actual yolk color may influence candling judgment only slightly, unless the color is very dark.

(2) *Yolk centering.* As the white of the egg becomes weaker, its hold on the yolk becomes less, and being lighter in weight than the white, the yolk leaves the exact center of the egg and rises. Hence, the expression "well centered" indicating finest quality and "fairly well centered" or "off centered" for eggs of less desirable quality.

(3) *Fertile eggs.* Before the egg is laid, the embryo in the fertile egg has been developing for several hours, and if the animal heat is not removed at once this development soon continues to such an extent that the embryo can be seen by candling. The temperature in the nest on a hot day may be 100 degrees F. or perhaps more.

When hens are laying heavily, or if broody hens are not confined regularly, the eggs may be at incubation temperature for several hours after being laid. The embryo, if well advanced, may die when the egg is cooled, causing the formation of a blood ring. This ring may be very small and is sometimes difficult to see before the candle.

A fertile egg, kept at a temperature of 68 degrees F. for several days, will develop slightly.

When the embryo dies, decomposition sets in, and in time the egg rots.

Males have no influence on the number of eggs a hen may lay. They are necessary only when fertilized eggs for incubation purposes are desired. Males should not be present in a flock which produces eggs for market after the breeding sea-

son is over. It is particularly important that the males be removed from the laying flock during the warm weather months of late spring and summer.

(4) *Infertile eggs.* An infertile egg will not rot if the shell is kept dry, but the quality will quickly deteriorate at temperatures above 60 degrees F., or in dry air.

(5) *Freezing.* Freezing must be guarded against, as it breaks down the white and may crack the shell, either event preventing the egg from being of first quality. Eggs freeze at about 28 degrees F.

B. Moisture. Relative humidity of 75 per cent or higher surrounding eggs is desirable. Low humidity in the egg-holding room causes moisture to be drawn from the egg. Some moisture is drawn completely through the shell, resulting in an enlarged air cell, while some is stopped where it spreads between the layers of shell. A pronounced mottled appearance of the shell is often traceable to low humidity in the egg-holding room.

C. Absorption of odors and flavors. The egg readily absorbs odors, which may or may not be lost in cooking. Care should be taken to keep the eggs away from filth, disinfectants, decaying vegetables, or any other substances possessing a disagreeable odor.

3. The standard 30-dozen case [1]

The 30-dozen egg case has become the standard shipping package on this continent (Fig. 145).

Wood for egg cases should be tough, non-warping, light-colored, non-staining, odorless, light in weight, and low in price. Cottonwood, tupelo, spruce, and gum are commonly used and are mentioned in the order of their desirability.

[1] *Dimensions of the 30-dozen case.* The outside dimensions of the standard 30-dozen case are: 13 inches high, 12 inches wide, and 25 inches long. These cases are constructed of thin material. The sides, top, and bottom are 3/16 inch thick, the partition and the ends 3/8 inch thick, with a cleat 1/2 inch by about 1 1/8 inches nailed to the ends on the outside.

Cases constructed of composition board instead of wood are in use but have not yet proved superior in practice.

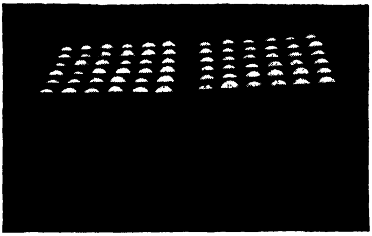


FIG. 145. A case of eggs well sorted for size and packed for market. The net weight of the eggs in this case is 49.75 lb. or 2.2+ oz. each. See Figs. 133 and 135.

A. Weight of fillers.[1] The quality of fillers should always be considered, since they are responsible for much of the breakage in transit. The heavier fillers are sufficiently superior in strength to justify the slightly higher price.

B. Color of fillers. The strawboard filler is the one most commonly used. The white fillers are most attractive and, for a high-class trade, justify the extra price.

C. Second-hand cases. Second-hand cases can be used to advantage if in good condition. New fillers and flats should be kept on hand to replace broken ones.

4. Home preservation of eggs

In many homes, regardless of whether poultry is kept or not, it is desirable to preserve eggs during the spring of the year when eggs are plentiful and prices are low. For long holding, low temperatures (not below 32 degrees F.) are recommended, regardless of how treated. In all heat-treated eggs, humidities up to 80 per cent (relative) are desirable. Eggs properly preserved may be held for several months in a cool cellar and used during the following fall and winter.

[1] *Weight of fillers.* Fillers for 30-dozen cases are machine made (M. M.) of the following grades: No. 1, weighing 3¾ pounds per set; Special, 3½ pounds; Medium, weighing 3 pounds per set; and No. 2, weighing 2¾ pounds per set. The Medium and Special 3½-pound grades are the most popular for domestic use; No. 1 is sometimes required if the eggs are to be placed in cold storage or exported. The fillers and the flats separating them are made of hard calendered strawboard, except in certain patented designs such as the Mapes cup flats made of news pulp and others made of spruce pulp.

Water-glass Treatment. Of the many ways of preserving eggs at home, the water-glass solution is the most popular.

Preparing water glass: Materials needed for 30 dozen eggs:

18 quarts water[1]
1½ quarts water glass (commercial)
2 eight-gallon earthen or metal containers.

Clean the containers with soap and warm water, and rinse. Pour the water into the crocks and add the water glass. Mix the water and water glass thoroughly with a clean stick or long-handled spoon.

Candle or tap the eggs together gently in order to detect any cracked eggs. Only fresh, sound, uncracked eggs should be placed in water glass. Lower the eggs into the solution, several at a time, with a long-handled dipper or spoon.

The crocks may be filled at once or the eggs added daily as gathered.

Five quarts of additional water to each 1½ quarts of water glass may be added if needed to cover the eggs, which should always be kept submerged. Place a cover on the container.

Eggs may be removed as needed. Water-glass eggs should be punctured with a pin in the large end for boiling to prevent the shell from bursting.

Flash-heat Treatment reported by Romanoff.

Method: Eggs are dipped in boiling water for 5 seconds and allowed to cool.

A very thin outer layer of albumen is coagulated, and slows down the usual rate of deterioration. Longer dipping shows the appearance of thin, white threads of coagulated albumen on the opened surface.

Moderate-heat Treatment developed by Professor E. M. Funk, University of Missouri.

[1] Work by Dr. G. O. Hall, at Cornell, showed ordinary clean water as satisfactory as boiled water previously recommended. Also metal containers were as desirable as earthen.

Method: Submerge eggs in water at 130 degrees F. for 15 minutes.

COMMUNITY SURVEY

1. What percentage of the poultrymen whom you know have special rooms for holding market eggs until shipped?
2. Inquire of one or two of them what features they have found desirable in their egg rooms.
3. How are their eggs sorted for size?
4. What benefit does this bring to the poultryman?
5. Name the sizes used by the poultrymen.
6. What percentage of the eggs need cleaning? How are eggs cleaned?
7. Do these men candle their eggs?
8. At what season of the year are eggs candled?
9. How many poultrymen visit the markets occasionally to confer with the market men?
10. List the handling methods and the care given the eggs from the time eggs are laid until shipped from the farm. How can these practices be improved?
11. In one day's collection how many eggs weighed 2 ounces or over? How many were chalk-white? Checked? Dirty? Poorly shaped?
12. How are eggs cleaned?
13. Describe how eggs are packed for shipment.
14. Do the poultrymen in your community use new or second-hand cases and fillers?
15. Where do they buy cases, and in what quantity?
16. What is the difference in price between new and second-hand cases?
17. What is the rate on a crate of eggs from your farm to the market? What percentage is shipped by train? by truck? What percentage of the output is disposed of through local sales?
18. What prices are being received by several of the poultrymen in the community?
19. What reasons can you give for the differences received?
20. What are the estimated costs and time required for preparing eggs for market?

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CHAPTER XV

PREPARING POULTRY FOR MARKET [1]

While it is necessary to give detailed attention and thought to all matters pertaining to the production of eggs and poultry, the ultimate success of the enterprise will depend to a great degree on the manner in which the products are marketed. The appearance of the birds sent to market has a great bearing on the price received.

Where meat varieties are kept, or a special trade is developed, careful attention to the proper preparation of the birds will be amply repaid. Not only does a discriminating trade enjoy the appearance of poultry which is well fattened and well dressed, often paying a premium for appearance as well as for quality, but there should be a genuine feeling of satisfaction on the part of the person who knows how to do this end of the work well, and who can and does put up a product which is decidedly pleasing in every respect. Such a person is proud of his products and takes pleasure in showing his wares to a prospective customer.

LIVE VS. DRESSED POULTRY

A large amount of the poultry sold for consumption is marketed alive. Commercial egg producers and persons keeping Mediterranean varieties usually cater to the live-poultry market. Marketing live poultry takes less time and requires

[1] For a more complete discussion of this subject, the reader is referred to *Marketing Poultry Products,* fourth edition, by Benjamin, Pierce, and Termohlen, published by John Wiley & Sons.

less equipment, both of which items are of great importance where commercial egg production is followed.

For poultrymen located near the large markets, especially New York, the live-poultry market is particularly desirable if shipment can be made just before the Jewish holidays.[1]

The price is usually 1 or 2 cents higher immediately preceding these dates. The Jewish market takes most of the

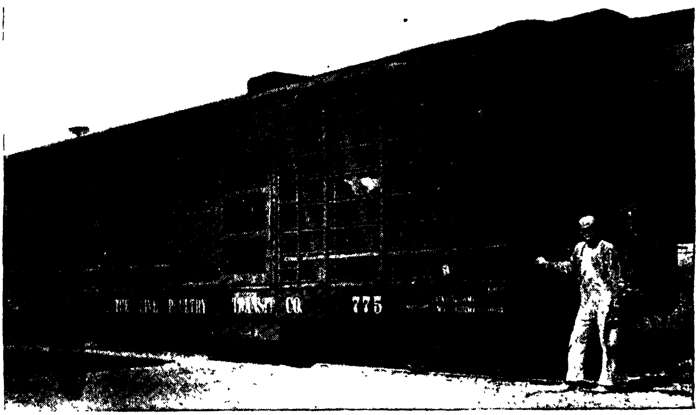

FIG. 146. A live-poultry car.

live poultry. As payment is usually made more on the basis of weight, and less on that of quality, than in the sale of dressed poultry, the care in preparing live poultry is reduced to a minimum. Through the Middle West, poultry is collected from farms and shipped in special cars holding 4000 to 5000 birds (Fig. 146). Sometimes these birds are held for a short period in feeding stations and fattened before shipment.

Small lots of poultry usually cannot be shipped long distances as satisfactorily alive as dressed. The shrinkage in weight of live poultry runs from 8 to 12 per cent. Dressed poultry usually brings a higher price per pound, and the express

[1] Ask your market man for a list of these days.

charges are the same.[1] Killing and picking, however, require considerable experience, equipment, and time. For this reason, and in view of the fact that bleeding the bird and removing the feathers cause a loss of 10 to 14 per cent of the live weight, each poultry keeper must decide for himself, after learning the marketing conditions, which is the wiser thing to do in his particular locality.

Operations:

1. Deciding when to sell.
2. Deciding how to sell.
3. Crating live poultry for shipping.
4. Preparing for killing.
5. Methods of killing.
6. Methods of picking.
7. Cleaning the carcass.
8. Cooling.
9. Packing for shipment.
10. Drawing fowls or roasters.
11. Trussing.
12. Cutting fowls.
13. Preparing broilers.
14. Deboning.
15. Home canning poultry.
16. Preparing poultry for the freezer.

1. Deciding when to sell

Fowls are sold or used for meat during the year when they cease to be profitable as producers or breeders or when the price for them is in excess of their value as egg producers or breeders.

[1] The rate per pound is the same as that for the live poultry, when the live-poultry shipment is intended for market and the value does not exceed 50 cents per pound. Shipment of breeding stock, or stock having a value exceeding 50 cents per pound, is usually charged a higher express rate.

Influence of Cost of Feed and Price per Pound (Live and Dressed) on Returns Above Feed Cost at Given Weights

Leghorn Cockerels

Pounds live weight	Pounds feed	Feed cost per pound live weight*	Return above feed cost		
			Alive	Dressed †	
			@ $0.20	@ $0.20	@ $0.24
1	2.8	$0.07	$0.13	$0.108	$0.14
2	7.4	.092	.215	.171	.242
3	13.6	.113	.26	.194	.301
4	22.3	.14	.243	.155	.297
4.5	29.2	.162	.17	.07	.231

Using feed at 2½ cents per pound and live and dressed prices as shown, the 3-pound Leghorn cockerel gives the largest return above feed cost. Using columns 1 and 2 for reasonably well-grown birds, local prices may be applied to the other columns to determine the best weight to sell. Other factors, as labor and space available, may need to be considered.

Dual-Purpose Cockerels

Pounds live weight	Pounds feed	Feed cost per pound live weight*	Return above feed cost		
			Alive	Dressed †	
			@ $0.20	@ $0.20	@ $0.24
1	3.13	$0.078	$0.122	$0.10	$0.135
2	6.5	.081	.238	.194	.265
3	10.6	.088	.335	.269	.375
4	15.7	.098	.408	.32	.462
5	22.8	.114	.43	.32	.498
6	36.5	.152	.288	.156	.37
6½	45.8	.17	.20	.056	.296

* Estimated at 2½¢ per lb.

† Estimated @ 89% of live weight, bled and feathers off.

The time to sell broilers or roasters depends upon: (*a*) price of feed; (*b*) weight of the bird; (*c*) price of the bird per pound.

2. Deciding how to sell

Poultry both alive and dressed is sold from farms. Little time is used in preparing for the sale of *live poultry* which is sold from the farm:

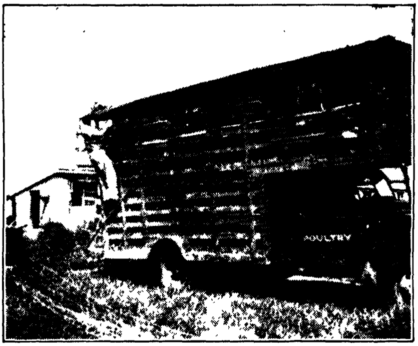

FIG. 147. A truck in the Del-Mar-Va region in southern Delaware and Maryland loading broilers for the haul into New York City.

(*a*) Direct to the consumer at the farm or delivered to the consumer's home.

(*b*) To the consumer through freezer locker service. Here poultry is delivered by the poultryman to the locker plant which prepares it for freezing and places it in the customer's locker or delivers it to the customer at the locker plant.

(*c*) Shipped to the receiver usually by express. The poultry is crated and taken to the express office or sent by truck.

(*d*) To a dealer at the farm. The dealer furnishes the crates and pays according to the weight at the farm. Returns are 3 to 4 cents less per pound at the farm than prices quoted in the market. The difference covers shrinkage and transportation charges and nets about the same to the poultryman.

(*e*) Through a cooperative association which may provide the necessary crates and return a price according to live weight or on the dressed, graded weight.

Dressed poultry requires most time for preparation. Chilling facilities are necessary unless the poultry is sold at once.

Dressed poultry is sold from the farm: (*a*) direct to the consumer; (*b*) to the retailer. To both outlets poultry may be *New York dressed* (bled and feathers removed), *eviscerated* or *drawn* (see pages 327 and 330), or *cut up* (see pages 331 and 334).

3. Crating live poultry for shipping

Do not overcrowd the birds, as this is likely to cause greater shrinkage. The many crates on the market differ widely in type, cost, and quality (Fig. 149). The requirements are that the crate be strong, handy, roomy, well ventilated, light, and reasonable in price.

The standard live poultry shipping crate is 3 feet by 2 feet by 12 inches high. The sides are spindles. Collapsible crates are available but less widely used. Twelve to 15 fowls or 15 to 25 broilers, depending on the size, are sufficient for one crate.

The birds should be well fed before shipment. If the birds are to be on the road for several hours, nail a can inside the shipping crate and put in soaked whole grain. No other water is given. The birds' crops should be empty or nearly so upon reaching the market.

4. Preparing for killing

Although fattening or special feeding is practiced in large poultry processing plants, it is much less prevalent on poultry farms than formerly. When properly fed on modern rations the condition is excellent and seldom demands special feeding. If the poultry is to be sold New York dressed, keep the birds without food for 12 to 15 hours, in order to empty the crop completely and, to a large extent, the intestines also.

Fig. 148. Weighing birds at the farm. A huckster is purchasing these birds at the farm, paying a few cents under the New York City quotation. This practice nets the producer about the same price per pound as if he shipped them to the city and received a price upon arrival. A 2 to 4 cent spread is often money ahead for the poultryman.

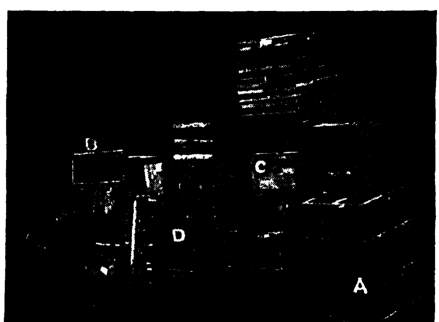

Fig. 149. Types of shipping coops. *A* and *D* are extensively used. *D* is more easily repaired than *A* or *B*. *C* is unsatisfactory from a ventilation standpoint.

A. The killing quarters. Where many birds are to be slaughtered, it is well to provide a place where the work can be done quickly and easily. A special room is available on many plants. Features needed are:

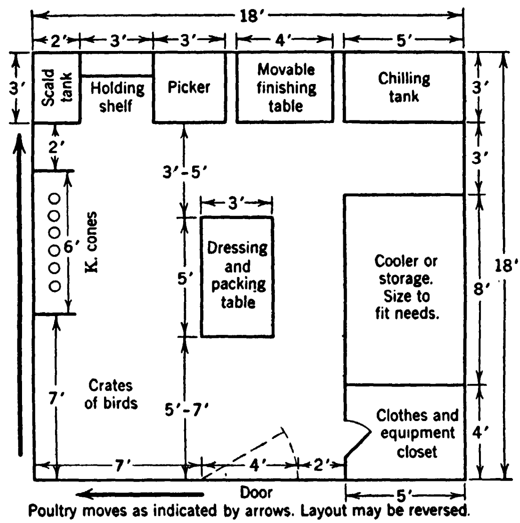

FIG. 150. Killing, dressing, and cooling room. A suggested guide for placing equipment.

A complete unit.
Ample size to do the job easily.
Operations progressively arranged.
Limited amount of carrying.
Crosswalking reduced to a minimum.

A room having 200 to 300 square feet of floor space will usually meet requirements on a 1000- to 1500-bird plant. Storage may require the larger space.

B. The killing equipment. The chart shows the larger equipment ordinarily used on plants where a number of birds are New York dressed or full drawn at one time. In addition,

smaller equipment consists of knives, singeing apparatus, string, waste containers, paper, and cleaning cloths.

For a few birds killing and scalding equipment may be a holding string or shackle (Figs. 152 and 153), weight or blood cup, and a boiler or large pail for scalding.

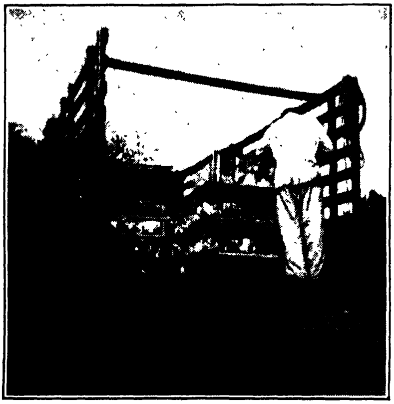

FIG. 151. Shipment of 200 fowl about to leave the farm.

5. Methods of killing

A. Sticking and debraining. Sticking in the mouth, when correctly done, gives the best bleeding. Where dry-picking is practiced, the brain is pierced immediately afterward, thus loosening the feathers.

Hang the bird up. Grasp the head with the left hand, comb in the palm and palm up. Hold the head with the fleshy part of the thumb and forefinger against the bones near the earlobes. Do not press against the soft part of the neck, as this stops the flow of blood. With the middle finger of the left hand, open the beak (Fig. 154). Insert the knife, being careful not to cut the throat, until the point shown in the illustration is reached (Fig. 155). Hold the knife crosswise in order to cut both blood vessels. Make a quick single cut, pressing against the neck. Making more than one cut is un-

necessary and not desirable because it gives more places for decomposition to set in.

When the bleeding is well started, debrain the bird. Hold the head as before, and place the point of the knife in the groove at the roof of the mouth and exactly between the eyes. Push the knife back on a line almost directly between the ear openings, until the base of the skull is reached. (See Fig. 71, for location of medulla, cerebrum, and cerebellum.) The point of the knife will strike the brain there and render the bird unconscious. Give a half turn of the knife to destroy the tissue.

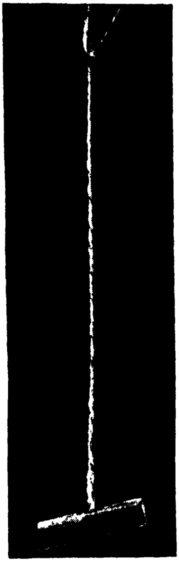

Fig. 152. A simple homemade contrivance for holding the bird while killing. The string is wrapped once around the leg and the block left at right angles to the leg. Do not tie.

When the proper point is hit, the bird gives a characteristic squawk. The feathers are loosened, if the stick is correctly made. Successful sticking and debraining require considerable practice.

B. Cutting off the head. This is perhaps the most common method of killing. The legs and wings are grasped with one hand and the head laid on a block. The neck is severed with a hatchet. The body and neck are held with the flat part of the hatchet until all bleeding and struggling ceases. The beginner may make a better cut if two nails are driven into the block, and the neck laid between the nails and drawn back until the head is held firmly, thus stretching the neck out. The bleeding caused by cutting off the head is satisfactory, provided a sharp instrument is used.

C. Dislocating the neck. This is a popular method where birds are to be full drawn. It is done by holding the legs in the left hand, and near the left hip of the operator (Fig. 157).

FIG. 153. Dry picking. Note wire bent to hold feet apart.

FIG. 154. Holding the head while killing. *Left:* The knife at an angle for cutting. *Right:* The knife in position for sticking the brain.

With the breast of the bird out, grasp the head, having the thumb at the back near the base of the skull, the palm against the face, and the middle finger across the under side of the beak. Bend the head back at nearly a right angle (Fig. 158). Holding the legs firmly, pull down sharply with the right hand.

The neck will separate at the base of the skull and sever the blood vessels there. Stretch the neck to provide space for the blood to accumulate. Bleeding is quite complete, all the blood being held in the neck, as the outside skin is unbroken. If the bird lies awhile before dressing, the blood coagulates and the usual method of dressing may be followed.

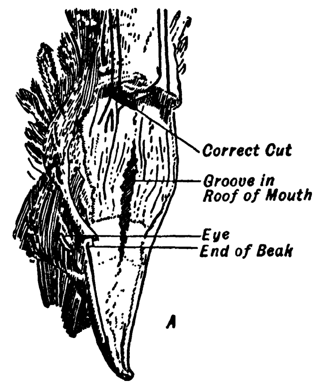

FIG. 155. Location of veins to be cut and the groove in the roof of the mouth through which the knife is inserted when debraining. From Bureau of Chemistry, U. S. D. A. Cir. 61.

D. Wringing the neck. This is not recommended.

6. Methods of picking.

A. Dry-picking.
B. Scalding and hand picking.
   (1) Full scald.
   (2) Semi-scald.
C. Machine picking.
D. Wax-picking.

A. Dry-picking. Hook a weight on the beak and start immediately to pick. Dip the fingers in water to make the plucking easier. Some prefer to lock the wings and pick with both hands, others to hold the wings near the body with one hand and pick with the other until the bird ceases to flop.

Grasp a handful of feathers and pull the hand over and down in a rotary motion. If the feathers stick, let them slip through, being careful not to tear the skin. Pick the feather tracts on the breast first as these are most likely to tear. Follow with the feathers on the thigh and back at base of wing. Next grasp the wing with one hand and all the quills in it with the other, and pull all out at once with a quick

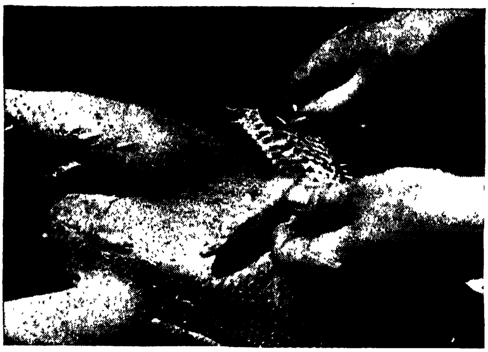

FIG. 156. Pinfeathering. The "stubbing knife" helps.

downward pull. Repeat on the other wing. Pull out the tail feathers next. Follow with the neck feathers. Any remaining large body feathers are next removed, after which the bird should be pinfeathered. A blunt-bladed knife helps in removing the pinfeathers, which are grasped between the blade and the thumb (Fig. 156).

B. Scalding. Scald-picked poultry is frequently less attractive than dry-picked because of cooking and tearing the skin. When scalding is properly done, the appearance is not materially different from that of dry-picked poultry.

Scalding is desirable in the case of birds intended for home consumption, and many markets do not object to it—some even prefer it.

(1) *Full scald.* The temperature of the water should be just below boiling (about 190 degrees F.). It is important to

avoid cooking the skin if birds are to be sold. Hold by the head and feet and keep these parts out of the water. Draw slowly through the water, with the feathers and not against them. Keep the bird moving to prevent the water from flowing between the feathers to the skin. This will steam the base

FIG. 157. Dislocating the neck.

FIG. 158. Dislocating the neck. With the head held in this manner, a straight downward pull separates the head and neck.

of the feathers. It may be necessary to dip more than once. Try the thigh feathers first; if they are loose, the bird will pluck easily.

(2) *Semi-scald.* The semi-scald method consists of moving birds back and forth before completely through flopping for 25 to 30 seconds in water, heated to 128 degrees F. for broilers and 130 degrees F. for fowls and roasters. This does away with much of the skin injury in scalding. The appearance and condition of the carcass are similar to dry-picked poultry.

C. Machine picking. Bleed, debrain, and semi-scald at 128 to 130 degrees F. Higher temperatures are unnecessary.

Place on the picker. Do not bear on. Holding the legs apart allow the bird to bounce and roll from side to side. With one hand on the head, roll the neck on the picker. Holding legs and head, set the abdomen on the machine. Do not try to get all the feathers off by machine, but handpick the balance.

It is possible to machine dry-pick properly debrained poultry.

D. Wax-picking. When lots of 25 birds or more are to be picked, the wax method may be used. A special wax can be purchased. Automatic electric wax heaters are best. The wax is heated to 127 to 128 degrees F. Water in another container should be warmed to about 85 to 90 degrees F.

The birds are bled and debrained and either semi-scalded or partially dry-picked. All quills and about three-fourths of the body feathers are plucked. Hang before a fan to dry and cool, from ¾ to 2 hours if semi-scalded and ½ hour if dry-picked.

Holding the bird by the head and feet, dip 1 to 3 times in the wax. After draining for ½ to 1 minute, immerse in the warm water until the wax feels rubbery.

Hang the bird up and peel off the wax soon afterward.

Collect the wax in containers, heat, skim off the feathers, and use the wax again.

The wax removes pinfeathers, hair, and other material, leaving a clean carcass.

Wax-picking appears to be losing in popularity, as more poultrymen favor the picking machine.

7. Cleaning the carcass

Before putting the birds away to cool, wash the feet. Clean the blood from the mouth, if sticking has been done. Give the head a quick downward thrust to dislodge any clotted blood.

LOSSES DUE TO DRESSING AND DRAWING

Based on live weight

Average weight, birds alive	Loss due to dressing (per cent)	Loss due to drawing (per cent)
Under 3 lb.	13	27
3 to 4 lb.	11	25
4 to 5 lb.	10	22
Over 5 lb.	9	18

8. Cooling

The animal heat should be quickly removed after plucking. The carcasses may be hung on racks and cooled in a temperature of 32 to 40 degrees F. A clean, cool cellar is very satisfactory.

The birds may be placed in clean, cold water, iced, and left there from 1 to 2 hours. Water cooling lessens the keeping quality if the birds are to be stored; but for immediate use it improves the appearance by smoothing out the wrinkles in the skin as a result of a slight absorption of water.

When thoroughly cooled, they may be packed.

9. Packing for shipment

It is good practice to wrap the heads. Wrappers of parchment paper may be bought. A common size for roasters is 7 inches wide, 14 inches long on one edge, and 7 inches on the other (Fig. 159).

For irregular or small shipments, the packages may be ordinary clean boxes or barrels. They should be lined with parchment paper and, in warm weather, should be packed in ice, unless short shipments are made or refrigerator cars are available. Place a layer of ice on the bottom, with the birds on that, breast down and legs toward the center. Alternate the ice and birds until the container is filled. Cover the top with ice and place burlap over that.

Large shipments of carefully graded poultry are packed in boxes of sizes to accommodate a certain grade. There are

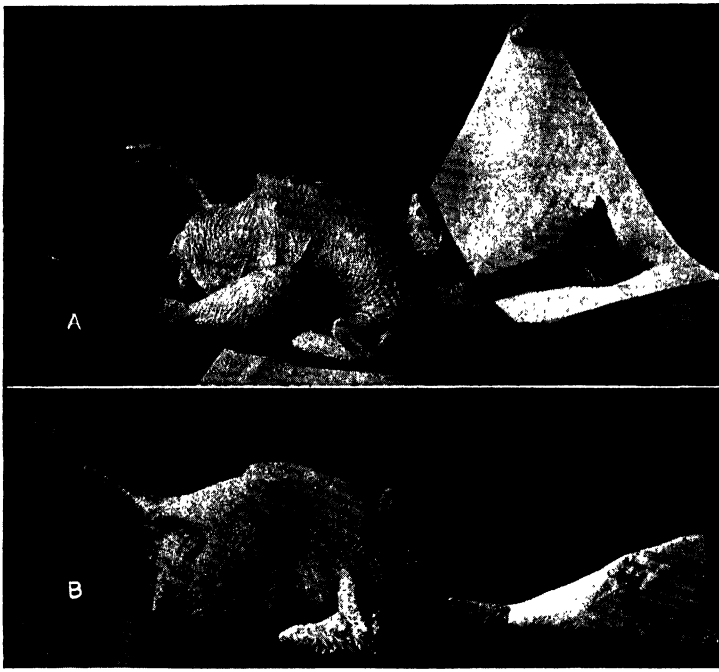

FIG. 159. Wrapping the head: *A*, the start; *B*, the finish.

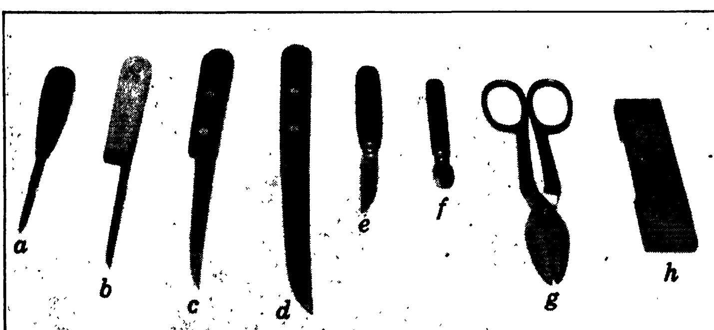

FIG. 160. Poultry killing and dressing implements: *a*, chicken killing knife; *b*, turkey killing knife; *c*, deboning or dressing knife; *d*, heavy cutting knife; *e*, dressing knife; *f*, pinner; *g*, shears; *h*, sharpening stone.

usually a dozen to the box. This method is to be preferred for the best quality of poultry and the most discriminating high-priced trade.

10. Drawing fowls or roasters

Until recently poultry to be shipped was never drawn. At present there is a tendency to draw poultry for shipment

FIG. 161. Shelf for dressing and tubs for washing poultry. The shelf is on hinges and folds upward against the partition.

when it can be immediately frozen and held in that manner. Otherwise it should not be drawn. If for home use, the following description, with accompanying illustrations of drawing, may be followed.

Singe the bird over a low alcohol or a gas flame, burning off the hair but not scorching the flesh. Denatured alcohol does not produce smoke to discolor the skin.

(*a*) Bird on breast, head toward you. Cut through skin from point between shoulders along back of neck to head. Separate skin from neck bone. Cut through flesh at both ends of neck, twist or cut with shears and remove.

a

a

b

FIG. 162. Drawing the bird. Steps *a* and *b*.

FIG. 163. Drawing the bird. Step *c*.

(*b*) Separate windpipe and gullet from skin. Reach forefinger into the body through front opening, loop under and around the gullet between crop and gizzard and pull out. Crop should follow. Cut off head. Insert forefinger and loosen lungs and heart.

(*c*) Bird on breast. Feet toward you. Cut through skin on rear of shank. Insert forefinger under a tendon and pull out or insert clothes-pin or stick under a tendon. Place the bird's foot flat against your body. Grasp stick on both sides of tendon and pull out. Repeat for each tendon.

(*d*) Place the bird on its back, tail toward your right. Cut between the vent and tail. Insert forefinger of left hand, loop up over the intestine and out the other side. Cut around the vent. If more room is needed, cut toward the right leg from just above the pubic bone.

(*e*) Remove intestines, gizzard, lungs, liver and heart. To remove kidneys work them loose from the back with the forefinger.

(*f*) Set the bird on its rump, back toward you, fold the neck skin down over the breast and scrape the upper surfaces of the wishbone. Insert knife under the bone and work loose at upper end. Repeat on other side. With point of knife and thumb work flesh away from the lower part of the wishbone and remove.

(*g*) Remove the oil sac.

(*h*) Trim heart, liver, and gizzard.

(*i*) Wash inside of carcass and wipe exterior with clean cloth.

(*j*) Singe, if necessary.

(*k*) Place heart, liver, gizzard, and neck in body cavity.

11. Trussing

The purpose of trussing roasting birds is to make the carcass compact and attractive. There are several methods. The following description is for the butcher's truss.

(*a*) Place the bird on its breast, tail toward you. Fold neck skin over the back. Bend each wing tip under and up onto the back to hold the neck skin.

(*b*) Place the bird on its back, tail toward you. Work a loop of string down over the front, back between the wings and

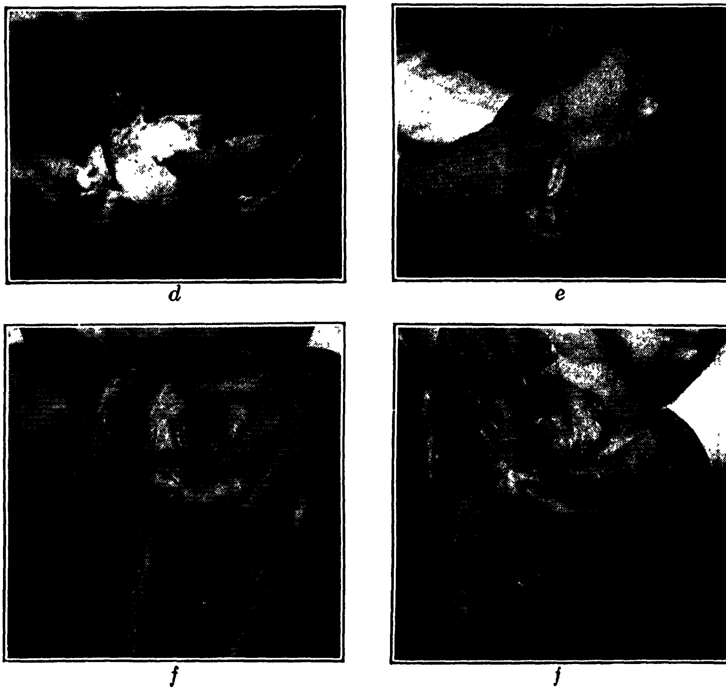

FIG. 164. Drawing the bird. Steps *d, e,* and *f.*

body, pull firmly, cross the string under the back, carry it up and over the drumstick near the outer joint. Pull down tight. Turn the bird over and tie the string across the tail.

12. Cutting Fowls

Certain retail stores and producers catering to private trade sell light and dark meat, soup and giblets. Others cut poultry into more parts for stewing or fricassee.

One method is described below.

(*a*) Remove shanks; cut around vent.

(*b*) Cut skin between body and thigh, bend thigh and leg back, dislocating thigh joint. Remove, and repeat on the other side.

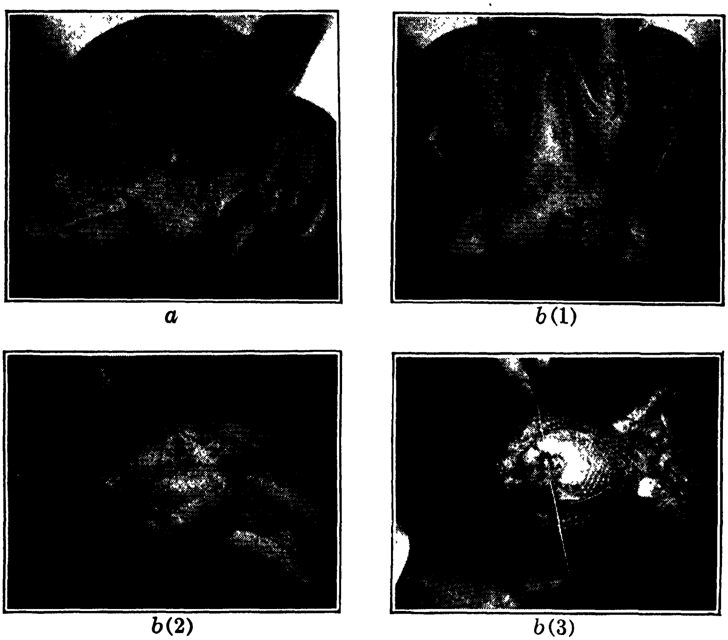

FIG. 165. Trussing. Steps *a* and *b*.

(*c*) Bird on side. Lay knife against body and cut forward through wing joint. Repeat on other side.

(*d*) Bird on side. Cut with knife or shears from pubic bone, straight to wing joint. Sever bone just below wing joint. Repeat on other side.

(*e*) Bird on back. Lift breast with left hand, tear attachments from beneath with right hand. Remove breast.

(*f*) Bird on side. Start at rear and separate intestines, oviduct, crop, and all organs from back, and esophagus and wind-

b

c

FIG. 166. Cutting fowls. Steps *b* and *c*.

pipe from the neck. Cut off head. The neck and back may be left in one piece. Remove oil sac.

(*g*) Clean liver, heart, gizzard.

For stewing or fricassee the carcass may be cut up further if desired.

(*h*) Separate drumstick and thigh.

(*i*) Remove neck bone close to the shoulder.

(*j*) Bend front part of back at joint and remove.

(*k*) Cut the wishbone free, cutting across near the front end of the breastbone, down to solid bone and then turning the knife to cut diagonally until free, leaving considerable white meat attached.

(*l*) Cut through skin and flesh down both sides of the breastbone, and, with the thumb, work breast meat away from the rest of bone. Cut the piece in half. Repeat on other side.

The abdominal fat is usually detached and delivered as a separate piece.

Back, thighs, and wings may be halved if the carcass is large.

13. Preparing broilers

A. Skinning broilers. Broilers may be picked by hand or machine. Skinning is quick. The skin is lost in the process.

The method:

(*a*) Dislocate the neck. Cut off shanks and wing tips.

(*b*) Break or cut the skin between the thigh and the body. (Bending the leg at right angles to the body will often break the skin and dislocate the joint near the back.) Repeat on the other side.

(*c*) Starting near the front of the breastbone, push the fingers under the skin over the middle of the back, break the skin across the back at that place and strip the back, thighs and drumsticks.

(*d*) Pull any remaining skin from the vicinity of the tail.

(*e*) Pull the remaining skin on the back toward the head until the neck is free.

(*f*) Grasp the large wing feathers and strip the skin from each wing.

(*g*) Twist and pull thighs and legs from the body.

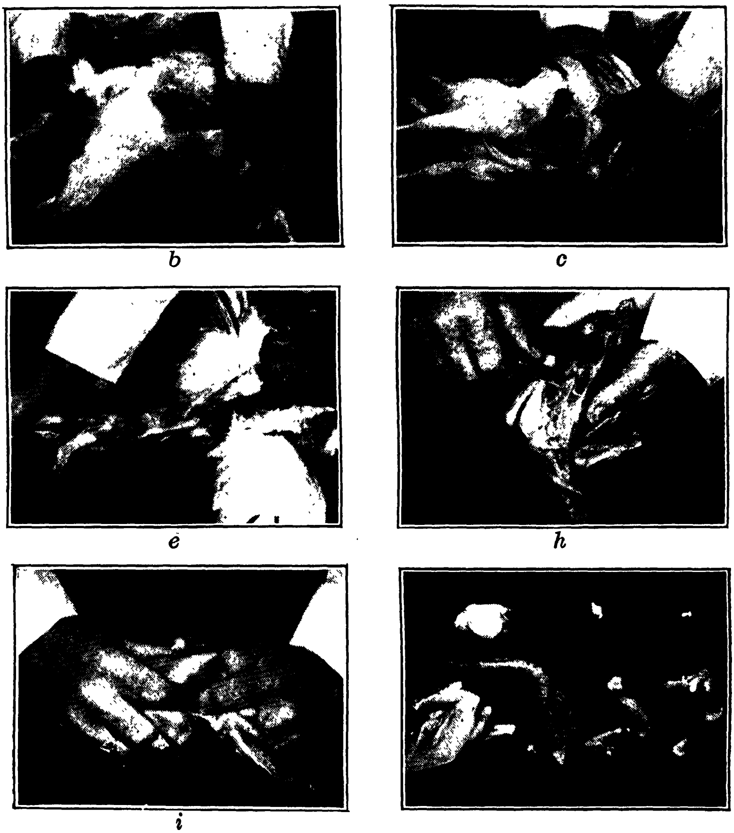

FIG. 167. Skinning broilers. Steps *b, c, e, h, i,* and the several pieces.

(*h*) Insert a thumb or a knife under the shoulder blades, tearing or cutting the muscles.

(*i*) Insert the forefinger of each hand in the cavity near the wishbone and, by pulling apart, separate the breast and wings from the back.

(*j*) With the point of a knife, cut the cartilage in the V at the front of the breastbone and flatten the breast.

(*k*) By pushing from below with a finger, remove the breastbone from the meat.

(*l*) Separate the intestines and other organs from the back and neck.

(*m*) Remove the neck and detach and clean the gizzard, liver, and heart.

B. Halving and Quartering a Broiler. The object is to cut the carcass to lie flat while cooking and to serve in halves or quarters, depending upon size of portion. It is desirable for use at home or for retail sale.

The method:

(*a*) Remove shanks, cut around vent and let hang free.

(*b*) Remove oil sac.

(*c*) With shears or knife, start near the tail, cut through the bones along side of backbone to the neck.

(*d*) Repeat on the other side of the backbone, slitting the skin on the neck to the head.

(*e*) Remove the backbone and neck in one piece, severing at the head.

(*f*) Place the bird on its breast. With knife, locate the base of the V at the breast in front, and cut through cartilage, pushing the two halves apart.

(*g*) By pressing from below snap out the breastbone.

(*h*) Halve the broiler.

(*i*) To quarter, cut from the approximate center of the back line to the rear of the breast meat.

(*j*) Clean giblets.

14. Deboning [1]

For private or family use, a carcass may be deboned. This is done by turning back the flesh, starting from the front, and gradually cutting the flesh loose from the bones, until only a

[1] For details see *Marketing Poultry Products,* by Benjamin, Pierce, and Termohlen.

mass of flesh is left. After stuffing and roasting, slices of both light and dark meat and dressing may be cut.

15. Home canning poultry

Cockerels and cull hens may be preserved for home use by canning, in order to avoid the expense of holding surplus stock alive until needed for the table. The canned meat retains its flavor.

Cut a chicken as for fricassee that will easily go into the jars. The flesh may be removed from the bones or not, as desired. Seasoning, such as celery leaves, onion, pepper, etc., may be added. Fill the jars to within ¾ inch from the top. Add 1 teaspoonful of salt for each pint. No water is necessary. Use new rubbers. Put the cover in place and partly seal.

Pressure cooker. Use a pressure cooker for most satisfactory results, following directions that come with the cooker. Generally, processing at 15 pounds pressure for 80 minutes is recommended for quart containers.

Hot water. Put the jars in the canner, in cold water. The water in the canner should not rise above the rubbers. Cook the jars of chicken 4 to 5 hours, counting from the time the water commences to boil. At the end of this time, remove the jars and seal.

16. Preparing poultry for the freezer

Recently the advantage of frozen food has been available to both city and country consumers by means of freezer locker plants and home freezers. Poultry can be placed in the holding compartment of the freezer with little extra effort or expense. When properly prepared, it retains its flavor and condition remarkably well.

(*a*) Dress and draw for roasting or cut up as desired.

(*b*) Wash the carcass thoroughly inside and out.

(*c*) Wrap the giblets by themselves. Wrapping is to prevent loss of moisture. A moisture vaporproof paper is recommended. The paper should not crack or become brittle at low

temperatures. The wrapped carcass may then be wrapped in a heavier paper.

(*d*) Make a compact package to exclude air and save room.

(*e*) Place the packages loosely enough to permit quick freezing.

(*f*) Freeze at zero or below.

(*g*) Store in the locker at zero or below.

COMMUNITY SURVEY

Talk with the poultrymen of the neighborhood about the marketing of surplus poultry and obtain answers to the following questions:

1. What percentage do they market alive?
2. What percentage do they market dressed?
3. Why do they prefer to market as they do?
4. What influence does the price received have on the method of marketing poultry?
5. What influence does labor have on the method?
6. At what age are the broilers marketed?
7. When is the broiler market best?
8. When is the market for cull hens best?
9. What size shipping crate is used?
10. How many birds are shipped in a crate? What is the shrinkage?
11. Draw a plan of a killing room in the community, showing location and dimensions.
12. Redesign the plan giving attention to saving steps and labor.
13. What types of picking machines are used?
14. Which methods of picking poultry are used?
15. Ask the older people of the community how chickens were killed years ago.
16. What is the express rate for live poultry from your station to market?
17. What is the express rate for dressed poultry?
18. Ask the express agent for regulations governing the shipment of poultry.
19. How is poultry dressed for market?
20. What suggestions can you give to improve the methods in use?
21. What is the status of frozen poultry in the community? Are frozen locker plants and home freezers in use? How is poultry prepared for freezing?

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CHAPTER XVI

SELECTING BREEDERS

It is clearly recognized that one of the most important means of reducing the cost of production is to have stock of high productive ability and give it proper care.

Selecting females and males is a fascinating job in many poultry flocks. Practice makes one more proficient in reading and interpreting the history of the bird's performance written as it is in various sections of the body. By physical examination much can be told about the laying ability of a bird, in so far as precocity and persistency are concerned (page 17). The breeder today, in selecting birds, often desires to base his judgment of a bird not alone on his or her performance, but upon that of the ancestors and even the progeny.

The steps involved in selection are like those of a ladder. In determining the worth of a breeding bird, selection starts with culling and ends with the performance of the progeny. Selection may cease with any step or it may include them all.

The manner of culling or eliminating the poor producers from the flock has been discussed (Chapter I).

Operations:

1. Selecting for longevity.
2. Selecting for vigor.
3. Selecting for freedom from physical and breed defects.
4. Selecting for production.
5. Selecting for performance of ancestors, brothers, and sisters.
6. Selecting for performance of progeny.
7. Selecting breeding males.

Select the breeders in the fall sometime after September 1. Band all desirable birds. At the same time the test for pullorum can be given (page 482). A later handling, just prior to the breeding season, is often helpful, preferably when the breeders are being mated.

1. Selecting for longevity

Give preference, other things being equal, to the older birds. It is not desirable, as a general rule, to breed from pullets. Either vigorous cocks or cockerels may be used.

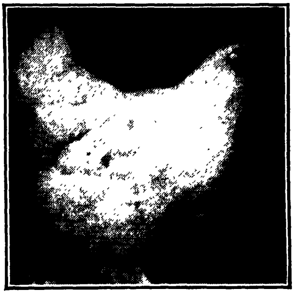

FIG. 168. K-2596. A White Wyandotte in her third laying year.

Production for the first year, 1921–1922, 208 eggs.

Production for the second year, 1922–1923, 179 eggs.

Record during third laying year, 156 eggs.

Record by 4-week periods; first egg, Nov. 19, 1921: 7–0–9–8–12–12–19–17–18–16–17–14–7. Last egg, Oct. 2.

Mature birds have proved their ability to live through many laying years and to survive the molt, whereas a pullet may die before her first year is completed. Any chickens which are hatched in the spring from a pullet which dies from a natural cause before the next breeding season may have a tendency toward a short life.

Mature birds have proved their producing ability; comparatively little is known about the pullet.

A greater percentage of chicks is likely to be reared from stock which is most physically fit at the time of mating, regardless of the age, provided each individual has reached proper sexual maturity.

Birds should not be discarded as breeders on the basis of age alone. If a hen lays eggs that hatch well, or if a male is strong and vigorous and properly fertilizes the eggs, the older they are the better. The fact that a fowl has reached a com-

paratively advanced age and retains its vitality and power to reproduce is evidence that it possesses, and therefore should transmit to its offspring, the tendency to live long and produce well.

Either cocks or cockerels may be mated with hens. However, in the event that pullets are used for breeding, cocks are better than cockerels to mate with them. The greater maturity of the cock will thus tend to counterbalance the lesser maturity of the pullet. In rare instances, where quick results from certain matings are especially desired, pullets may be used as breeders, but only when hens of the right type are not available. In case pullets are used, they should be large and mature.

The selection of female breeders, therefore, should be confined for the most part to pens containing mature birds.

2. Selecting for vigor

The use of strong, vigorous birds is essential, as it means better fertility and hatchability, and less mortality in chicks.

Examine carefully, in the flock, each bird that is a candidate for the breeding pen. Then handle the bird, as outlined in Chapter I.

The head is the most important character to indicate constitutional vigor.

High Vitality	Low Vitality
Head short and thick for the variety, full of color and life.	Head and beak long, thin, flat.
Beak short, heavy, curved.	Eye dull, sunken, with drooping lids.
Eye bright, full, prominent.	Comb limp, pale.[1]
Comb full, bright.[1]	

[1] Hens that have been laying heavily during the year are usually lower in vigor because of the large demand upon the body for egg production. The shanks are thin and pale and the face is likely to be thin and less highly colored. If the bird has completed her laying year, the comb will be shrunken, a condition which is indicative of a low state of vigor, at the time of observation.

A fowl carries its health certificate on top of its head. The comb

FIG. 169. Longevity.

Band	Weight of Bird in July, 1924	Weight of Egg	Age
Y6	4.1	26 oz.	5 Years

Trapped during and following the breeding season only in first four years.
Production by months during the fifth year:

Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
19	21	24	17	21	21	21	18	19	2	183

An excellent long-distance producer and breeder.
See one of her daughters. B-478 (page 370).
Nearly every egg laid during the hatching season produced a vigorous chick.

There is a correlation in the shape of the different sections of a fowl. For instance, a long, thin beak is associated with a long, thin head; long, thin neck; long, slender body; long, thin shanks and toes. These loose-jointed, long, slender types generally have low vitality.

3. Selecting for freedom from physical and breed defects

If the bird which is being examined possesses a high type of vigor, she should now be examined for defects. While, in some instances, birds having these defects may be retained in the

is the signal that shows the condition of the blood, which is an accurate index of the bird's health. One must determine whether the hen is normally a high-vitality bird and only temporarily low in vitality because of her heavy year's work, or mismanagement, or whether she is a naturally low-vitality individual by inheritance.

laying flock, they should not be allowed in the breeding pen.

If upon examination the following defects are found, throw the bird out.

Crooked beak. One mandible crosses over the other or twists (Fig. 170), or is broken, so that it is likely to bother the bird when eating.

Crooked or roach back. Run the palm of the hand over the back and observe whether the back is crooked or humped.

Slipped wing. Several primaries hang below the secondaries.

Split wing. A wing so irregularly formed as to show a distinct gap between the primaries and the secondaries.[1] A slipped wing carried to the extreme.

Decidedly wry tail. The tail is carried to one side instead of straight behind the head in line with the body.

Decidedly squirrel tail. A tail so held that when the bird stands erect the tail projects forward over the back toward the head, beyond a line drawn perpendicular to the ground.

Rumpless. Without the rump which carries the tail feathers.

Side sprig. A piece of the comb growing on the side of a single comb (Fig. 171).

Other comb defects. Pronounced fold, thumb mark, high blade on a single comb, absence of the spike, or a telescope spike on a rose comb. A telescope spike is one that appears to be pushed back into the comb.

Any bird having a split comb or a comb foreign to the breed should be discarded.

Foreign face color. Considerable white in the face, or red in the earlobe of Mediterranean varieties, or considerable white in the earlobe of American or Asiatic varieties, is not desired.

Pearl eye. A very light-colored eye.

[1] From *The American Standard of Perfection.*

Defects of shanks and toes. A bird with crooked toes is likely to be handicapped in foraging and scratching (Fig. 172).

Stubs. Most people who purchase purebred stock do not desire stubs or down between the toes or on the shanks of clean-

FIG. 170. A crooked beak.

FIG. 171. Note side sprig on the blade.

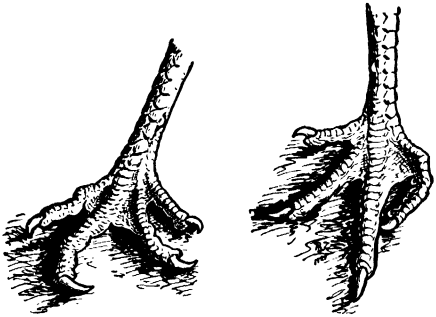

FIG. 172. A bird with several deformed toes similar to the crooked toe on the right foot should be discarded from the breeding pen.

shanked breeds. Keeping such birds out of the breeding flock will eventually insure a flock practically free from the defect.

Other examples are:

Legs and toes foreign to standard breed color.

Red, purple, or white feathers in any black variety.

Fig. 173. No. B-347. Note wide, prominent breast; blending of legs and neck with body and well proportioned head.

Fig. 174. No. B-458. Note width of body and prominence of breast. Laid 303 eggs in twelve months and 326 before removed to winter quarters on Jan. 4 to stop laying. After 2 months' complete rest this bird resumed heavy production, and practically every egg laid during a long hatching season hatched a husky chick.

Fig. 175. No. B-458. Note symmetry of head when comb is straightened. A desirable breeder for strong, cockerel heads. Note rugged refined type of head; alert, friendly expression; symmetrical face and strong beak. This bird was not only friendly but also affectionate.

Brown or buff (usually found on the breast, neck, or shoulders or in the quills or primaries or secondaries) in white varieties.[1]

4. Selecting for production

Now that the bird has passed the first three tests of a good breeder, namely, longevity, vigor, and freedom from defects, she is ready for a severe test, that of production.

FIG. 176. No. B-458. Note extent of molt while still laying, a condition often found in good birds.

There are two methods of determining the production value of a hen: (A) by studying her external characters and (B) by trapnesting.

A. Judging birds for production by external characters. Keep in mind the factors discussed in Chapters I and II for indications as to whether the bird is in production, when she stopped laying, and whether she had a vacation during the summer.

[1] The defects mentioned are the more common ones, for which the breeder should be constantly on the lookout. For other defects of Standard Bred Poultry, the reader is referred to *The American Standard of Perfection.*

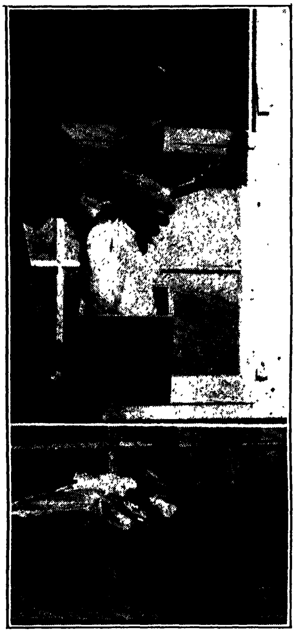

FIG. 177. Two views of a handy device for weighing breeders or other live poultry. The container should be built according to the breed of the birds to be weighed. It is made of wood and open at the bottom. It is attached to the scales by a tough flexible piece of leather or canvas in order that it may swing freely. This prevents the bird's flopping the wings and is a great time saver in weighing birds individually. Variations of this type are tin or galvanized iron cornucopias with open end for ventilation. Taken at Penn. State College.

FIG. 178. M-443. Note the alert expression in this head.

FIG. 179. M-443. A production Rhode Island Red. Note the full abdomen and deep heart girth which accompany good production. Note fine head characteristics.

Record, 210 eggs. Record by 4-week periods: 14–2–18–17–17–19–23–21–15–16–11–10–27.

First egg, Oct. 19, 1923.

A careful study and examination of each bird are necessary. It is well to spend considerable time studying birds, until the various points are clearly fixed in mind. After this it will be possible to progress much more rapidly with the selection.

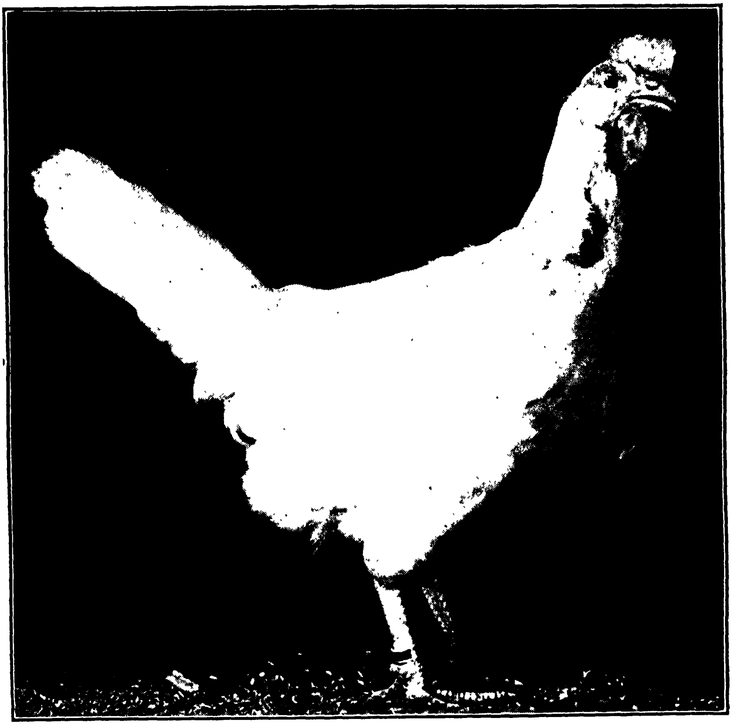

Fig. 180. A modern business Leghorn. Rugged refined head. Strong-boned, large-capacity, parallelogram-shaped body.

Head. The head should be clean-cut; the face, bright, well proportioned, and wider at the top than at the bottom. A "dished face," or one with a considerable depression under the eye or an inward curve from the top of the skull to the nostril, indicates weakness.

The beak should be fairly short, deep, and well curved, showing strength.

The eye should be clear and prominent.

It will be apparent after some study that birds differ greatly in their expression. The expression of a good producer is intelligent, shows character and alertness, but seldom shows fear when the bird is handled unless she is out of laying or in heavy molt. She has a bright, alert, snappy, defiant, and challenging expression. She appears to take an intelligent interest in affairs.

Birds with bald heads are frequently found in a flock. This peculiarity often indicates a thin skin and a good producer.

The head, both in the male and in the female, is an extremely important section of the body. It is the seat of the power that drives the machinery. That power, the brain, is the dynamo which controls the bird, and from which, through the spinal cord and its branches, energy is radiated to all parts of the body.

The head, as an indication of the brain power and nervous energy, is connected, in a very vital way, with the digestive, circulatory, assimilative, and reproductive systems. If the brain is not properly developed and active, all the other organs will fail to function as they should.

The bird with the proper nervous temperament well developed is responsive, active, and intelligent, and possesses the highest vitality and recuperative and productive powers.

Temperament is shown by a clean-cut, intelligent head, set well forward on the neck, and by the inquisitive expression of the eye. By studying the heads of birds, and simultaneously checking the results by means of other characters, one realizes that hens may be classified for egg production on the basis of the head.

Seven types of heads. (1) *Rugged refined.* This is the most desirable type and is associated with exceptional production of long duration over several years. This is the long-lived type of heavy producer. The head should be broad and flat across

FIG. 181. M-3991. A fine type of production Barred Rock. Note wide-awake, snappy expression, well-bleached beak, clean face, and well proportioned, rugged, refined head.

Her record for a year was 260 eggs, and she laid as follows by 4-week periods: 13–7–19–19–21–20–24–25–24–25–23–22–18.

First egg, Oct. 19, 1923.

FIG. 182. M-5249. A bright eye, clean-cut face, and refined head, which almost always are accompanied by high production.

The record of this hen was 221 eggs, and as follows for 4-week periods: 14–22–23–20–17–22–21–20–22–22–18.

First egg, Dec. 14, 1923.

FIG. 183. A crow head viewed from the side and front. Note the elongated thin head, sunken eye and face, shriveled comb, and dull expression.

the top, wide between the eyes, and of medium to large size but not coarse. The head shows rugged physical character, high mentality, and reproductive power—a high-powered bird. These characteristics are indicated by a substantial, smooth-textured comb, red face, and prominent, open, bright, expressive, inquisitive eye that is friendly but challenges you (Fig. 180).

FIG. 184. A masculine-type head. This hen has ceased to produce eggs and has taken on masculine characteristics. Note coarse comb, dull eye, and overhanging eyebrow. There is absence of alertness and reproductive urge. Neither masculine nor feminine. A deficiency type.

The best examples of this type should be expected to lay 250 to 300 or more eggs the first year and 200 or more per year for several years thereafter. Such a bird is a rare individual.

Character and expression are difficult to describe; but even the average observer, unskilled in selection, should be able, after a little practice, to pick the birds having these qualities.

(2) *Refined.* This is a desirable type, associated with high first-year and possibly later production. The head is strong, well proportioned, clean cut, and not fat. There is no sign of weakness. The features are well proportioned and of good color. A bright, full, prominent eye in a well rounded eye socket radiates character. The comb is medium to large in size, of soft texture but not thin or limp (Fig. 185).

This type should be expected to lay 200 to 250 eggs per year.

(3) *Overly refined.* This type may lay well for a time, perhaps for several months, but lacks staying power and is not desirable for use as a breeder (Fig. 186).

The head is usually too small, and indicates too rapid development. The face is likely to be sunken below the eye and

the comb thin and limp. Extreme fineness of features may accompany a body lacking in the highest type of vitality. The overly refined hen may be retained as a layer, provided she survives the culling (see Chapter I), but is not the type to use for breeding even though she may have laid 200 eggs or more in 12 months.

The production is likely to be 150 to 200 eggs per year.

(4) *Crow-headed.* The long, narrow beak and head, small limp comb, and sunken eye denote a generally weak bird and

FIG. 185. A refined type.

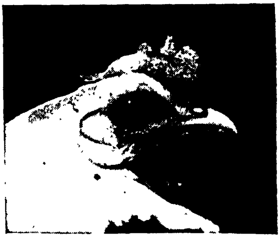

FIG. 186. An overly refined type.

one readily susceptible to colds and disease. The type is a poor producer and seldom survives the summer culling. Such birds may lay 100 to 200 eggs.

(5) *Coarse.* The heavy, coarse head falls in this class. Overhanging eyebrows accentuate the coarseness. Refinement is lacking, and the face is wrinkled. The eyes are much less alert than in the previous classes, and the expression is dull and inactive. Birds with this type of head have a tendency to take on fat, and are usually culled during the summer. The comb is frequently oversized, thick, and rough. A few survive the culling but should be wintered only as layers (Fig. 187).

This class is likely to produce 50 to 150 eggs per year.

(6) *Phlegmatic.* Birds of this type lack character, have a listless expression, dull eye, and lay from 25 to 100 eggs.

(7) *Masculine.* This type is marked by the large, coarse comb and wattles. It may occur in hens whose ovaries have

been destroyed by tumors or from some other cause. Such hens develop masculinity, and for some time a person may be puzzled to determine their sex.

Production 0 to 50 eggs per year (Fig. 184).

Body type. The type of a bird's body indicates her capacity as a producer rather than her immediate laying activity. The best birds, layers and breeders, must have desirable body type, but all birds having this desirable body type are not the best layers and breeders. The right body type must have included in the make up of the hen the urge to lay or the inherited tendency to high production. Correct body type, therefore, is necessary in our best birds, but is not of itself a proof of high production.

FIG. 187. Coarse head and sunken face. Not likely to make a high record.

To examine the bird for body type hold the legs as previously described, and rest the breast of the bird on the knee, head toward you. This is done in order to allow the body to relax and the bones to stay in their normal position with respect to each other.

First measurement, heart girth. Notice the way the ribs spread and also the distance between them (Fig. 192). The greater the bulge through the central part of the ribs, the more capacity there is inside for heart and lungs and the more desirable is the type.

Turn the bird on her side, back toward you, and, with the thumb on the back near the shoulders, place the forefinger or middle finger on the front of the keel. The distance to the front of the keel should be relatively deep and the keel well forward, giving a full chest.

A high-producing bird must have a large strong pump, the heart, and strong elastic arteries to conduct blood to all parts of the body.

In addition, plenty of room is needed for the lungs, since large volumes of air must be used to purify the blood. Any constriction or weakness in these vital regions is disastrous and prevents the proper functioning of all parts.

FIG. 188. No. B-458. High production but egg underweight. Note full, deep body; low tail carriage; alert expression.

Sept. 16, 1924. Weight, 4.9 lb.
Weight of egg: 23+ oz. per doz.
Body: Remarkable width of back and depth of body.
Heart girth: Very wide.
Keel: Medium length and curved.
Lateral processes: Very wide.
Head: Small to medium; round; bald headed.
Eye: Prominent; bright bay; expressive; slightly depressed.
Comb: Medium size, 5 points; blade raised slightly. Texture smooth and velvety.
Beak: Short and thick.
Face: Slight feathering.
Earlobes: Small, bluish white; slight red in lobe.
Shanks: Small, thin, pale.
Abdomen: Very full and deep; very soft and pliable.
Plumage: Very white.
Disposition: Very quiet and friendly; intelligent.
Molt: Slight neck molt; molted 4 primaries.
Date of first egg: Dec. 3, 1923.
Production per month:

Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
26	24	24	24	27	25	29	28	27	25	21	21	2	303

Second measurement. From the small of the back to a point midway between the front and rear of the keel.

Holding the bird in the same position, move the thumb along the back and the fingers along the keel at the same time,

and observe whether the keel tends to slope away from the back. The depth through the center of the body from back to keel should be as great as or greater than the distance from back to front of keel. The bird which is less in the former measurement, or one in which the keel is parallel to the back, is not desirable. Depth of body is very important. (It must be remembered that this distance may vary somewhat during the year according to the production of the bird. When the bird is in full laying, the keel is pushed down, and when she is not laying it moves up toward the back.) (See Chapter I.) It has been found by careful measurements that during heavy production the intestines become about twice as large as when the egg organs are dormant. This is due to a stretching of the walls. The intestines do not gain in weight, but their contents decidedly increase and the walls grow thinner.

Fig. 189. Hen No. 408. A head typical of a non-producing bird.

Third measurement, back. Place the thumb on one hip and the middle or forefinger on the other (Fig. 193). Notice the width at the hips.

Notice the width and flatness of the back, all of the way to the tail and forward to the ribs. That back is best which holds the width well, and is flat and smooth. The flatness of the back varies in different breeds, varieties, and strains. The Leghorn is of the flat-back type. Any roundness between the hips may show a tendency to fatness and is undesirable.

Place the thumb and fingers again at the hips and move to the rear and downward (Fig. 194). Notice whether the hand spreads, or is drawn together, indicating great width through the ischium, Fig. 77, which is desirable, or "cuts in," which is undesirable.

A broad back appears to be the one best character for esti-

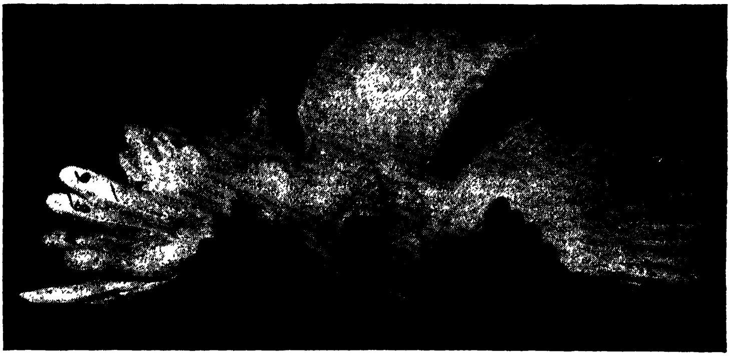

FIG. 190. Hen No. 408. Picture snapped Sept. 16, 1924. Wing shows three primaries full grown, indicating 8 to 10 weeks' molt.

FIG. 191. Hen No. 408. An average to low producer.

Sept. 16, 1924. Weight, 3.8 lb. Not laying.
Weight of egg: 26 oz. per doz.
Body: Medium to wide back, gradually narrowing to rear. Medium depth of body.
Heart girth: Medium.
Lateral processes: Narrow.
Head: Small to medium. Fairly short.
Eye: Slightly sunken, expressive, bright bay in color.
Comb: Small, shrunken; 5 points narrow serrations; blade slightly elevated.
Face: Fairly full, slightly feathered.
Abdomen: Soft, shrunken.
Pigmentation: Very yellow beak, face, eyes, vent, lobes, and shanks.
Molt: Nearly complete new coat. Wing primaries show 8 to 10 weeks' molt.
Date of first egg: Dec. 2, 1923.
Production per month:

Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Total
16	20	18	23	11	24	23	13	0	143

mating intensity, i.e., the power to lay many eggs in a given time.

Narrow hips, the ischium or pelvis tapering in rather than out, and the back from the hips to the tail sloping down tend to restrict the passageway, giving it the form of a funnel, with

FIG. 192. Measuring heart girth. Width.

the result that the hen is rarely a good producer and has a low intensity.

Fourth measurement, keel. Lay the bird again on its right side, and lay the palm along the keel, letting the fingers extend beyond the rear end. Move the fingers up to the pubic bones (Fig. 195). Notice the length of keel, whether the rear is curved up, and how far it extends to the rear toward an imaginary line dropped perpendicularly from the ends of the pubic bones (Fig. 77).

The medium-to-long keel, which will tend to give full sup-

FIG. 193. Measuring back. Width at hips.

FIG. 194. Measuring back. Width through the ischium or pelvic section.

port to a large abdomen, is a desirable character. Such a keel, therefore, helps to prevent sagging of the abdomen, which

FIG. 195. Measuring keel. Length and straightness.

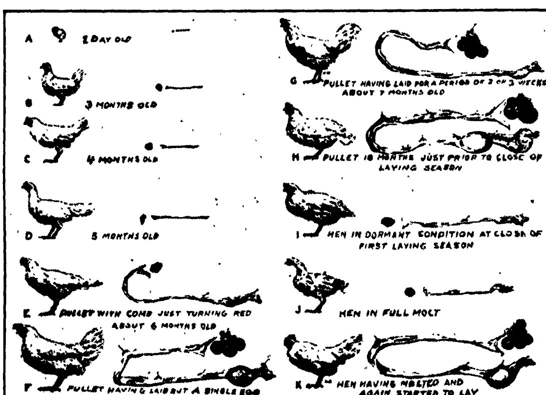

FIG. 196. The physical changes and reproductive development from the baby chick to laying pullet to dormant hen and back into production again. Note condition of head and plumage as compared with size of reproductive system during different stages of development and molt.

might interfere with digestion, affect the health of the bird, and lessen production.

Molt. Review Chapter II.

Quality of skin. With the thumb and fingers, feel of the skin at the abdomen and at the side and note the texture. A

thin, soft, oily, flexible, light-colored skin denotes a good producer. A thick, hard, dry, yellow skin is often underlaid with hard fat, is coarse, and goes usually with poor production.

Feathering. The smooth, tight-feathered bird, which holds the wing close and compact, is likely to be the better layer. The fluffy, loose-feathered bird, with a wing that "cuts in," indicating loose feathering, is less desirable from an egg-production standpoint.

FIG. 197. M-1657. A production Barred Rock. Note the deep, wedge-shaped body.

Her record was 231 eggs, and she laid as follows by 4-week periods: 2–12–25–24 2–18–24–24–26–13–18–16–27.

First egg, Nov. 3, 1923.

Activity, carriage, and temperament. The high producer, while always active, is nevertheless not flighty. She is alert and ready to avoid any possible danger, but does not "lose her head" because of fear, as a low producer so often does. When held she often "talks back." In other words, a high producer is intelligent.

The carriage of the tail is a variable factor. It is a breed characteristic and does not appear to influence production.

B. Trapnesting. By applying the practices outlined in this chapter thus far, one can separate the flock into desirable and undesirable producing birds with considerable accuracy. To select birds according to the five important characteristics [1] closely associated with high production one may examine the flock during the year and leg band for each character (Chapter II). However, trapping birds makes the latter selection easier. Moreover, to progress more rapidly in establishing a desirable strain, one must pedigree hatch and select breeders

[1] Precocity, persistency, intensity, no winter pause, and non-broodiness.

by use of the Progeny Test. In this work trapping is essential. The authors, therefore, introduce trapnesting at this point.

FIG. 198. No. B-347. A hen combining excellent production and high egg weight. Note deep, full, well-proportioned body and excellent carriage.

Sept. 16, 1924. Weight: 4.3 lbs.
Weight of egg: 26+ oz. per doz.
Body: Exceptionally wide back, and deep body.
Heart girth: Extremely wide.
Keel: Medium length and curved.
Lateral processes: Wide.
Head: Medium size, short, round, very broad top and back. Partly bald.
Eye: Bright bay, full, expressive, snappy.
Comb: Medium to large; 5 points wide at base; blade horizontal; texture very soft and velvety.
Beak: Strong, well curved.
Face: Very smooth and full; clean.
Earlobes: Small, almond shaped, white.
Shanks: Short, pale, small.
Abdomen: Soft, full, pliable.
Plumage: White.
Disposition: Quiet, alert, intelligent.
Molt: No wing or body molt.
Date of first egg: Nov. 30, 1923.
Production per month:

Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
1	21	23	21	25	24	25	23	22	26	23	23	22	279

Daily trapnesting for 12 months is the surest method of determining a hen's production. It is necessary in order to do individual pedigree breeding. Records must be kept which show the actual egg record of the dam, and the breeding records back of the sire.

Trapnesting is often done during only a part of the year,

i.e., during the breeding season, in order to secure a record of intensity (the number of eggs laid per month), or to determine the egg quality of an individual, or in order to test the birds for fertility or hatchability. This method is also used where it is desired to make a progeny test, i.e., to select breeders on the basis of what their daughters are capable of laying, both in numbers and quality of eggs, or what the daughters of their sons are capable of producing.

The practice of trapnesting requires considerable labor. This may be at the rate of about 1000 hens per day per person on an average for a year. The traps should be visited five to six times a day. It is not, as a rule, practicable for commercial poultrymen to use this method on the entire flock, unless it is a small one.

The production values of the ordinary run of hens can be determined more economically by physical examination. Moreover, except in the hands of a careful breeder, trapnesting may be dangerous, because of the temptation to pay greater attention to the known egg record than to the other three factors which should be considered first, namely, longevity, vigor, and freedom from defects. Selecting and mating birds on the basis of high production alone will eventually result in impaired vitality, lower egg production, smaller birds and eggs, and ultimate failure.

Egg quality. Only those hens which produce eggs having large size, proper shape, true color, and good interior quality for the variety should be retained in the breeding pen. If the birds are being trapnested, the quality of egg can be readily noted. In many flocks there is vast room for improvement in egg quality. Size, shape of egg, and color of shell are inherited.

All eggs produced by any one hen tend to be of a characteristic size, shape, and color, although they may vary somewhat. Trapnesting permits one to observe these characteristics of the eggs laid by each hen. An average of these characters in eggs laid by any hen gives a better idea of the type of egg the resulting pullet will lay than does the selection of eggs only

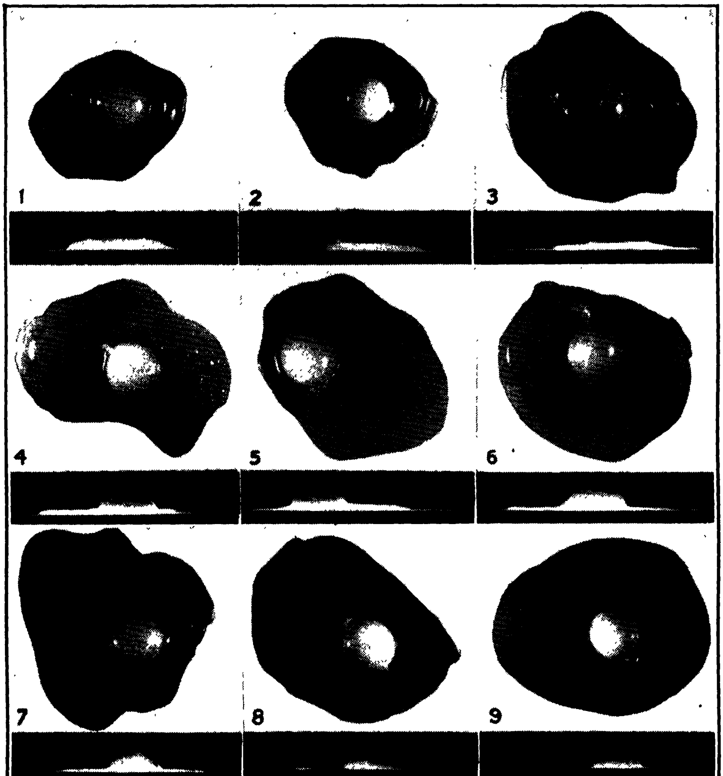

Fig. 199. Albumen condition of eggs. Individual hens differ in the albumen condition of their eggs. Each egg was broken out the day it was laid. Note the typical uniform yolk condition found in such eggs. Note also the great variation in albumen condition from very firm white in 1 to complete thin white in 9. The height of firm albumen may best be seen in the side view just beneath each top view. Photograph from Van Wagenen and Wilgus.

at incubation time. Eggs produced by pullets after 6 months of laying are reasonably close to the average size for the year.

It has been shown that the mother's performance in egg-quality characteristics is transmitted to her daughters with a fair degree of regularity. Egg quality is also transmitted through the sire.

The pedigree breeder of the future may need to know not only the number of eggs and the exterior quality but the interior quality of the eggs produced at various seasonal periods of the year as well.

Five important characteristics. There are five factors generally accepted in research and commercial breeding work as associated with high production. They can be used to judge the value of an individual as a producer, or the daughters may be measured by them to judge the value of either the dam or the sire as a breeder. The factors are: *precocity, intensity, no winter pause, non-broodiness,* and *persistency.*

Precocity and persistency have been discussed (Chapter II).

The importance of possessing as many of these characters as possible is shown in the following table for Rhode Island Reds at the Massachusetts Agricultural Experiment Station.[1]

Number of Characters	Number of Birds	Percentage of Birds	Average Egg Production
0	31	1.35	149
1	158	6.87	157
2	375	16.30	174
3	717	31.17	201
4	648	28.17	227
5	371	16.13	252

The *intensity* of production is a very reliable index of a bird's inherited tendency to lay. It is affected by feeding and management in about the same way as precocity and persistency.

Intensity is measured by the number of eggs per month or

[1] F. A. Hays and Ruby Sanborn, "Breeding for Egg Production," Bulletin 307.

week, or the number of eggs that a hen will lay without skipping a day. Certain hens may have a monthly intensity of only 8, 10, 12, or 15 eggs, whereas others will lay 20 or even 30 eggs. The intensity can be measured at any time when the fowls are laying normally.

Intimately associated with intensity are *cycle* and *rhythm.* The length of the cycle is the number of successive days on which the hen lays an egg. This varies considerably among individual hens. The total production is greatly affected by the number of days in a cycle, that is, whether the hen lays one or more eggs before skipping a day.

Rhythm is the regularity of the cycles. One bird may skip a single day between cycles, whereas another may skip varying periods, from 2 days to a week or more.

The birds with the highest intensity are usually the best annual producers.

STANDARDS FOR SELECTION OF BREEDERS SUGGESTED

	By Hays for R. I. Reds	By authors for W. Leghorns
Age at first egg	215 days or less	180
Weight at first egg	5.5 pounds or more	3½
Intensity (winter cycle size)	3 or more eggs	3
No winter pause of more than	7 days	7
No broodiness	No broodiness	No broodiness
Persistency	300 days or more	315 or more
Egg size	Not under 24½ ounces for pullets Not under 26 ounces for hens	24 oz.
Laying house mortality	Not over 15 per cent	15%

Winter pause may be several days skipped between cycles during the winter. It signifies a lack of power to carry on. A partial molt sometimes occurs. Days out of production mean lower annual production. Some research workers believe that winter pauses of several days, 4 to 8, are inherited and, there-

fore, such birds should be eliminated from the breeding flock.

Broodiness influences the spring, summer, fall, and annual production, but such birds may have as high or higher winter production as those that are non-broody. A bird may go broody once or several times during a season. In any event, time is lost, and the tendency should be to reduce the amount of broodiness where egg production is the aim of the breeder (pages 513 and 514).

The broody tendency is inherited and can be greatly reduced by rigid selection.

5. Selecting for performance of ancestors, brothers, and sisters

Pedigree hatching[1] makes it possible to carry the selection a step farther. The hen measuring up in each of the preceding requirements is an excellent performer. Her value as a breeder will be more nearly assured if it is known that the parents descended from a line noted for its ability to pass the same tests.

Similarly when a bird is found to be one of a large family, all or most of which lived and passed the tests, the selection is made still stronger.

The performance of ancestors and brothers and sisters increases the possibility of a desirable performance by the individual.

6. Selecting for performance of progeny.

The highest type of breeding work, and the one which promises the most rapid and complete success, is reached when the worth of a bird as a breeder is judged by the way the progeny perform.

The power of an individual to transmit its characteristics to its offspring is called prepotency. Animals differ greatly in their ability to do this. For example, certain hens, themselves high producers, can transmit high production to their offspring; others, though equally high producers, are unable to produce pullets which are even average in production. In fact, it some-

[1] Described and illustrated in Chapter XIX.

times happens that hens which are only medium producers are capable of getting high production in their offspring.

The value of the progeny test is at once apparent, as by it both males and females with high prepotency for producing desirable or undesirable qualities are discovered. Males and females must be good producers of layers, in order to be satisfactory breeders.

FIG. 200. Hen No. B-478. A rugged refined head, full of character. Note strong beak and face and very expressive, bright eye.

More money value is represented in this quality of prepotency than in any other single quality of a bird.

It will be found when all records are brought together that the progeny of various matings differ greatly in their ability to live and survive the culling and selection tests.

To accomplish this the bird having passed the five important characteristics, page 365, is mated. The fertility[1] and hatchability[1] of eggs and the viability of the chicks are checked.

After the rearing season the progeny of promising families are housed and records of their performance kept.

7. Selecting breeding males

The male should preferably be one whose sisters, half sisters, and daughters have been tested. However, as a cockerel, if bred from a family of outstandingly good producers and breeders, he is more likely to transmit the qualities desired than if not so bred.

Examine the males for longevity, vigor, and defects, as outlined for the females.

Body. The heart girth, width of back, and depth of body should be relatively somewhat similar for the males and the females.

[1] Discussed in the next chapter.

The main difference is found in the relative width and depth of the front and rear of the body of the high-production-type male. It has proportionately a broader and deeper heart girth and not quite as much width and depth of body as the production-type female.

The body should be relatively deep in front, and as deep

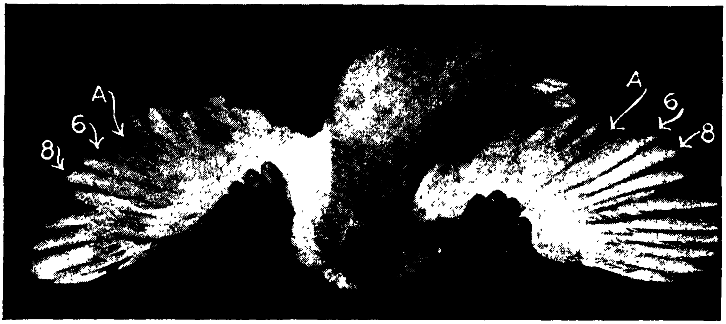

FIG. 201. Hen No. B-478. Numbers denote weeks of molt. Wing primaries show 8 to 9 weeks' molt. A fine type of hen as indicated by head and body; apparently thrown out of production early in July by being moved, passed through a nearly complete molt but has resumed production after shedding 4 primaries. Many good hens are culled yearly because of wrong conditions which force them into molt early in summer. Correct management and a knowledge of type and head will do much toward correcting such mistakes.

at the center. The rear is likely to be more shallow on a good male than on a good female.

The length of keel is important, the long, well curved keel being more desirable.

Head. The head should be distinctly masculine, i.e., well proportioned, and round rather than long when viewed from the side. It should show good character and well developed secondary sex characters (comb, earlobes, and wattles). It should be clean cut and the expression bold and alert.

The blade, on single-comb varieties, as the Leghorn and Ancona, should follow the neck rather than extend upward. The points should be wide at the base and not too high. The

FIG. 202. Hen No. B-478. (See Fig. 201.) An example of excellent type and vigor, but a victim of circumstances.

Sept. 16, 1924. Weight, 5.1 lbs. Laying.
Production to Apr. 15, approximately 91 eggs. Thrown out of trapnest house because of a breed defect. Production started Dec., 1923.
Body: Wide back; extra deep body.
Heart girth: Very wide.
Keel: Short and curved.
Lateral processes: Medium width.
Head: Medium size, short, strong, wide, round.
Eyes: Very expressive, bright bay. Full of nervous energy.
Comb: Warm; medium size; 5 points wide at base.
Beak: Strong, well curved.
Face: Slightly feathered, slightly sunken.
Earlobes: Medium size; slightly red.
Abdomen: Full; soft.
Pigmentation: Lobes slightly creamy; shanks medium yellow.
Molt: Body, neck, and tail feathers new and nearly grown. Four wing primaries shed. Had ceased shedding primaries and resumed production.

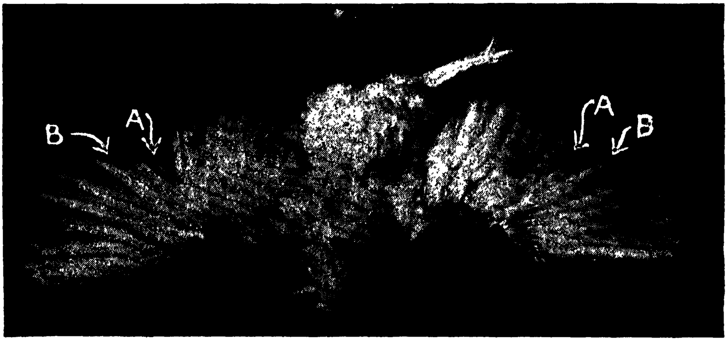

FIG. 203. Hen No. B-172. *A*. Axial feather. *B*. First primary showing 5 weeks' growth. A good producer may sometimes shed and lay at the same time over a limited period.

FIG. 204. Hen No. B-172. Low intensity; short length of laying period. Bird out of production 11 days. Evidently started molting neck and wing while still laying. Note heavy body molt which with fair body type and soft abdomen denote a moderate producer even though molting in August.

Sept. 16, 1924. Weight, 4.3 lb. Not laying.
Weight of egg: 26 oz. per doz.
Last egg: Sept. 5.
Body: Medium width of back; slopes away quickly to tail.
Heart girth: Wide.
Keel: Medium length and straight.
Lateral processes: Medium to narrow.
Head: Medium in width, rather long.
Eye: Very bright, flashy, prominent; dark bay.
Comb: Small; 6 points; blade small, slightly raised.
Beak: Rather long.
Face: Slightly sunken and feathered.
Earlobes: Greenish yellow.
Abdomen: Soft, shrunken.
Pigmentation: Yellow returning to vent and beak and slightly to shanks.
Molt: Molting heavily, body and wings; neck, nearly complete. Wing shows 5 weeks' growth on first primary molted.
Date of first egg: Nov. 9, 1923.
Production per month:

Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Total
11	18	18	17	12	18	21	20	20	18	2	0	175

narrow, pencil points, small, high blade, and thin comb are usually associated with a narrow, erect body, and are not desirable characters. They are typical of the wild fowl and are found most frequently when a strain of fowls runs out or reverts to the primitive low-producing type.

Behavior. Always select the male for gallantry, courage, and frequency of crowing and mating. These indicate masculinity, i.e., the development and activity of the reproductive system.

The temperament is important. The good male is unafraid. He is not necessarily one that is continually fighting, but one whose presence is respected by other males and females.

Pre-breeding season handling. Look over all males and females previously marked as being desirable for breeding purposes. Examine each one critically, and discard any that appear to be weak or in any way are out of condition.

COMMUNITY SURVEY

1. Visit one or more poultrymen who sell eggs to a hatchery. Are they selling eggs from pullets, hens, or both?
2. When are their breeders selected? Is there more than one selection?
3. What points do the poultrymen consider in selecting breeding hens? Where do they secure their breeder males?
4. What breeding background makes these males desirable?
5. Visit a poultry breeder. Is he doing pedigree work? Does he carry it into the progeny test and how does he do this?
6. How many families is he testing?
7. What outstanding results does he attribute to his breeding work?
8. How many poultrymen trapnest their birds?
9. What percentage of the flock is trapped?
10. To what extent are these records used in selecting breeders?
11. Is there a state or national Poultry Improvement Plan operating in your state?
12. What are its breeding stages?
13. Do the local breeders belong to it?
14. Why or why not?

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CHAPTER XVII

MATING THE BREEDERS

To make the useful more beautiful and the beautiful more useful is the highest aim of the science and art of poultry breeding.

Breeding is the science and art of mating animals or plants with the expectation of securing in the offspring definite results in the development of certain specific characters. These characters may be vigor, longevity, type, habit, plumage, prolificacy, egg quality, meat quality, rapidity of growth, broodiness, etc. The forces that produce these qualities exist in the body of the individual and are increased or decreased by selection and breeding.

Improvement of poultry is brought about by the action of two great natural forces: environment, which includes food, surroundings, and climate; and selection and mating, which include both natural selection and mating and the purposeful selection of poultry practiced by man.

Natural selection and mating are the actions of the slow, uninterrupted forces of nature. They influence and modify all animal and plant life and have given rise to the phrase "survival of the fittest." Nature secures a high type of vigor and perpetuates the race, because under natural conditions only the strongest can survive. Inbreeding is not so likely to be detrimental in the wild state as it is under domestication, because only the strong live; but the process used by nature is too slow and does not accomplish all the results desired for the purposes of man.

Under the conditions created by man, all the individuals generally have a chance to live, and man must select those best

suited to his needs and ideals. To meet with success, this selection must be rigid, severe, thorough, and for definite purposes.

The next problem is mating the breeders.

Operations:

1. Deciding when to mate the breeders.
2. Deciding the number of hens per male.
3. Eliminating the influence of a previous mating with a different male.
4. Studying methods of mating.
5. Securing fertility and hatchability.
6. Considering the four main systems of breeding poultry.

1. Deciding when to mate the breeders

The birds should be mated at least 2 and preferably 3 weeks before eggs are to be saved, although the eggs may be fertile after a particularly active male has been with a small flock 3 or 4 days, provided all environmental conditions are favorable. Eggs should not be saved more than 10 days or 2 weeks before incubating. Since, for *normal spring hatching,* chicks of the Mediterranean varieties should be hatched from February to May, inclusive, in the latitude of New York State, and those of the American and Asiatic varieties from 1 to 2 months earlier, it follows that the breeders should be mated 6 to 8 weeks before the chicks are expected.

When hatching is to be done at *other seasons of the year* (see page 398) mating must occur at the proper interval before the eggs are needed.

Producing fall chicks from hen breeders. The demand for chicks from hen breeders is based on sound reasoning. A problem has been to secure good production, fertility, and hatchability in the fall from hens to meet the demand for early chicks or for winter broilers.

Work by Dr. G. O. Hall of the Cornell University Poultry Department indicates that the artificial control of egg production during the summer months is possible and that such con-

trol may be used as a means of greatly increasing the number of all chicks which may be hatched from hens. Not only would such a procedure be practical, but where there is a demand for fall chicks from hens it should materially increase economic returns.

However, controlling egg production in the early summer months merely to obtain high egg production during the fall is not economically sound.

The best results were accomplished by restricting food and water for a short time and excluding all daylight from June 1 to August 16. Light from 8 A.M. to 4 P.M. daily was provided by a 60-watt bulb through a blue filter which gave the birds only sufficient light to eat and drink. After August 16 the birds were placed under normal conditions. Results below compare restricted feed only, Pen A; restricted feed and light, Pen B; and Control, Pen C.

FERTILITY, HATCHABILITY, AND VALUE OF CHICKS

Two years combined, September to January 1943–1944 and 1944–1945

Group	No. eggs	Inf.	% Inf.	Number chicks	% hatch total eggs	% hatch fertile eggs	Value of chicks 1944–45
Pen A, avg.....	237	73	30.80	132	55.48	80.18	4.22
Pen B, avg.....	413	107	25.93	233	56.36	76.10	6.73
Pen C, avg.....	198	91	45.70	67	33.58	61.86	2.06

2. Deciding the number of hens per male

For Leghorns, 1 male to about 20 females should be allowed. Eggs have shown high fertility where 1 male to 30 or 40 females has been used. For American varieties, allow 1 male to about 15 females. For Asiatic varieties, allow 1 male to about 10 females.

In order to insure satisfactory fertility early in the season, it is necessary to use a smaller number of females than would be required if hatching were done later in the season.

3. Eliminating the influence of a previous mating with a different male

If it is desired to change males during the breeding season, and have no influence of the former male in the progeny, at least 3 weeks should elapse from the time the first male is removed, until eggs are saved from the mating with the second male.

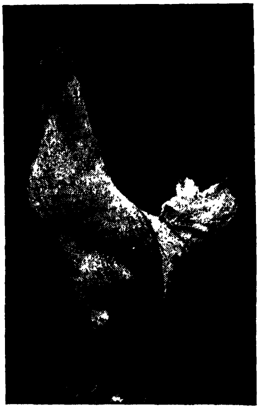


FIG. 205. A type of low-production White Leghorn male. The weakness of this bird lies in his poor body, especially the shallow depth at the rear, the narrow heart girth, and narrow, tapering back.

4. Studying methods of mating

There are several methods by which the selected breeders may be mated.

(1) *Large flocks.*[1] Most commercial flocks are bred by the large-flock method. A number of hens and males are placed in the pens together, sometimes as many as several hundred birds. Practically no serious fighting takes place if more than two males are in the flock and they have sufficient floor space and range. Chicks cannot be pedigreed as the male parentage cannot be known. Carefully selected females mated with males from desirable blood lines have given excellent results in the laying ability of the pullets. This method provides many hatching eggs at a very much less expense for labor and housing.

[1] The Breeding Labyrinth. Occasionally the fertility is low because of the interference of a few males. If this trouble is serious, a breeding labyrinth may be placed in the pens. This consists of boards or panels about 1½ or 2 feet wide and 10 or 12 feet long, placed 6 or 8 inches above the litter. The length will vary according to the pen in which it is used. It should be within 2 or 3 feet from the front of the house and the edge of the droppings board. Mating occurs more frequently where the labyrinth is used, as the males cannot see other males at the

(2) *Small flocks* or *pen matings* are used when a few choice individuals are mated with a single male. The parentage of each chick is known since, by trapping, the identity of the female is determined.

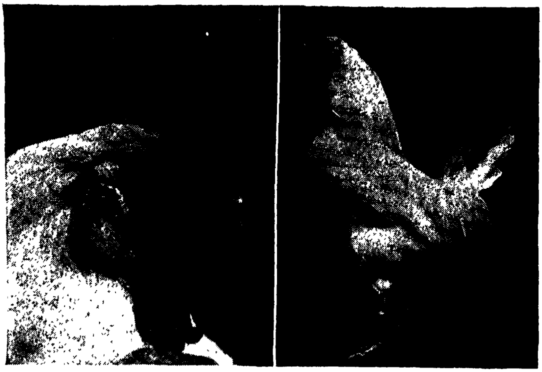


FIG. 206. A long-lived type of White Leghorn production breeding male. Note masculinity; alert, fearless, keen, intelligent expression; short curved beak; large, blocky body.

This method permits line breeding and progeny testing and reaches its best possibilities on a breeding farm using several such pens.

Alternating males. If signs of preferential[1] mating are noted, or if the flock is so large that 1 male cannot be expected to fertilize the eggs satisfactorily, or if one is not pedigreeing, 2 males may be used alternately. In this case, the

time of mating, and therefore do not interfere with them. The labyrinth will also greatly lessen the fighting among the males and thus insure better health and mating vigor, because the males are enabled to eat and drink without being disturbed. A somewhat similar result is secured when mash and grain hoppers are properly placed about the floor of the breeding pen.

[1] Males occasionally mate with certain hens, to the exclusion of the others, with the result that eggs from other hens in the flock are not fertile.

changes should be made about twice a week and the male not in use should be rested in a coop. This eliminates all interference and fighting.

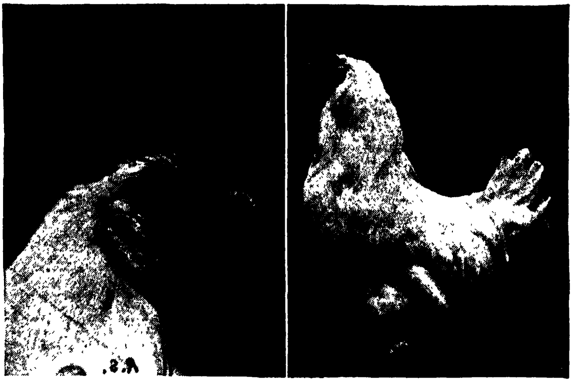


FIG. 207. A high-quality White Leghorn production breeding male, age 4 years. Note the well-shaped comb, aggressive active expression.

Weight: 6.9 lb.
Back: Extremely wide, carried well back.
Depth: Very deep.
Heart girth: Wide.
Keel: Long and curved.
Shanks: Heavy, roundish, short, thick; well pigmented; large spurs.
Head: Very masculine. Rather coarse; large, round, wide.
Face: Clean; somewhat sunken under eye.
Eye: Slightly sunken; light bay; aggressive.
Earlobe: Large; smooth; ivory, tinted with pink.
Comb: Large; 5 points wide at base. Blade below horizontal. Texture, soft.
Beak: Thick and strong; heavily pigmented.
Plumage: Naturally white.
Tail carriage: About 45°.

(3) *Stud mating.* In large flocks it may be desired to mate certain males with certain females while the latter are running together. This may be done by trapnesting and stud mating. The males are kept in coops, about 2½ by 3 feet and 3 feet high, 1 male to each coop. A record is kept of the band numbers of the hens to be mated with a particular male. When a hen is removed from the trapnest, she is placed in the coop with the male with which she is to be mated and released at the next trapping. To help guard against error, the males and

females to be mated together may have leg bands of the same color.

If the proper records are kept, the parents of each chick will be known.

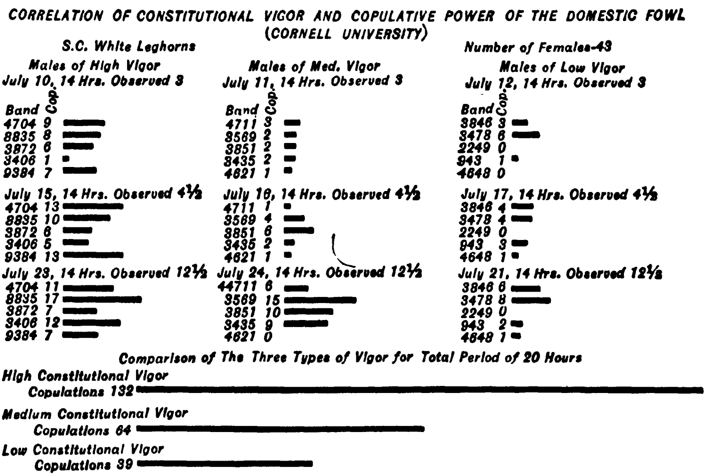


FIG. 208. Strong, vigorous males are desired in the breeding pens. The high-vitality males mated nearly four times as often as the low-vitality males.

5. Securing fertility and hatchability[1]

Perfect incubation would be obtained if every egg incubated hatched into a strong chick capable of developing into a full-grown bird. Practically every egg that is set but not hatched is a loss in several ways, viz.:

(*a*) The egg itself is changed from a marketable to an unmarketable product.

(*b*) It occupies incubation space, which might have been used to hatch a chick.

[1] Much depends on the health and physical condition of the breeders. Birds should be completely rested and recuperated physically before the breeding season. (See page 166.)

(*c*) It requires the attendant's time and care, and expense for fuel.

(*d*) There is delay in obtaining the expected number of chicks, owing to the necessity of replacement in a later hatch if the loss is serious.

Two factors are of primary importance in the effort to secure good hatches: (*A*) fertility and (*B*) hatchability.

FIG. 209. Old males frequently develop long, sharp spurs which may seriously injure the hens while mating and males when fighting. With a saw remove ¼″ to ½″, thus leaving a blunt end.

A. Fertility. Infertile eggs may be the fault of either the hen or the male. If the fault is due to preferential mating on the part of the male, it will be necessary to mate the hen with another male. Closely confining males, as in stud-mating coops, for several weeks may affect their physical condition and thus lower fertility.

Well selected stock, carefully housed and fed, should aid fertility.

Gallantry may cause males to eat too little. Special grain feeders 18 inches up and on the wall may solve that problem for males.

Climate affects the mating of poultry to a marked degree.

Matings are much less frequent during very cold weather. Freezing comb or wattles may affect fertility. To protect males, *dubbing* is rapidly becoming general practice. At 8 to 12 weeks of age the comb and wattles are cut off with shears. There is no need to check bleeding.

Fertility is higher among hens laying eggs in cycles of more than 3.

Hens copulate more frequently and have longer duration of fertility following insemination when ovulation rate is rapid.

Highest fertility is obtained during periods of highest egg production.

B. Hatchability. Not all fertile eggs will hatch. Certain hens will show higher hatchability than others having similar treatment and care and showing similar fertility. Hatchability is inherited, is an individual trait, and, if the birds are trapped, low-hatchability birds may be removed, thus raising the flock average.

One of the distinct advantages of using trapnests is to be able to learn the hatchability of the eggs of each hen in the foundation breeding pens. It is important, therefore, that the poultry breeder know the hatchability of the eggs of his best breeders and that he take steps early to correct faulty results and secure the largest hatching efficiency. Either the breeding, feeding, housing, or incubation may be responsible for the number of chicks which a hen may produce in any season. Close inbreeding usually results in lowered hatchability in succeeding generations.

Eggs must be gathered frequently during cold weather to prevent chilling. Nutrition is extremely important, since the factors affecting the growth of the embryo and the health of the bird must be provided.

Provide range for the breeders, or an outside sunporch, for several weeks before and during the breeding season, if possible, since eggs laid under these conditions usually hatch best.

Avoid using breeders that are in poor physical condition

because of overproduction or as a result of improper feeding prior to or during the hatching season. This may apply to either hens or pullets.

It does not follow that high production annually, or during the breeding season, necessarily results in less fertility and hatchability. On the contrary, the highest fertility and hatching quality should be found among the highest producers.

A careful examination of the birds that show poor results in hatching will frequently disclose the cause to be loss of weight. The feeding should be checked. If eggs are fertile and hatch well early in the spring, they are likely to do so through the season, but not necessarily so. Therefore, trapnests may be installed in February or March, and the breeders banded and their eggs tested. A hatchability of 85 per cent or better of fertile eggs is a workable standard for the individual hen.

C. Testing for fertility and hatching quality. Mark the egg with the hen's leg-band number, and let the first lot of eggs incubated be a trial hatch. Record the hen's number on a sheet, with the number of eggs from each hen. Keep a record of the infertile eggs and dead germs from each hen. Just before the eggs pip, on about the eighteenth day, place the eggs from individual hens in wire baskets. When they are hatched, record the number and quality of chicks from each hen. Discard from the breeding pens any hens continuing to show low fertility, poor hatchability, or weak chicks, if upon careful examination it is found that the cause for poor hatching quality cannot be overcome.

6. Considering the four main systems of breeding poultry

Selecting good breeders is but the first step in poultry breeding, for unless the birds are wisely mated the results may be unsatisfactory. The improvement of poultry through breeding depends on the sustaining hand of man. Progress is slow and laborious, and the pitfalls are many. One may mount the ladder of success, step by step, only to fall back to the starting point through one misstep—an undesirable mating.

The practices here discussed are the principal ones in poultry breeding work: inbreeding, with line breeding a special form, out-crossing, grading, and crossbreeding.

A. Inbreeding. The closest form of inbreeding is mating together closely related individuals as brother and sister, father and daughter, or mother and son. Close inbreeding is used to

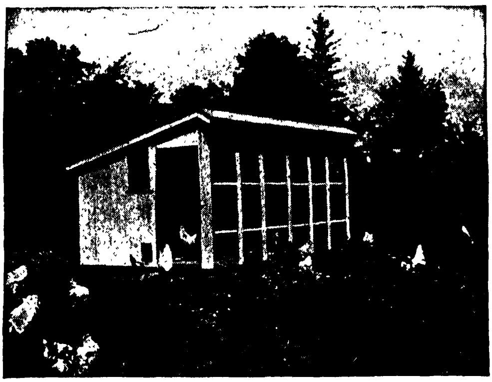


FIG. 210. Summer quarters for old breeding males. At the close of each breeding season remove the best males from their pens and place on a shady, green, isolated range. Ship the other males to market. Provide many feeding hoppers and drinking places. Note the open house and excellent forage conditions.

secure uniformity in a character but cannot be practiced long in any blood line. Undesirable characters show up quickly. The failure of close inbreeding to produce desirable results each time may be due largely to man's inability to select the combinations of vigor required.

Research workers find that, in general, close inbreeding lowers production, vigor, hatchability, rate of growth, and fertility; retards sexual maturity; increases mortality; and shortens the length of laying period.

From the above it will be inferred that close inbreeding is a dangerous practice for the average breeder; but this does not mean that out-crossing is necessary every few years.

Mating together more distantly related birds, as first or second cousins, uncles and nieces, and the like, is often necessary. If selected carefully, particularly for high hatchability, the procedure is justified.

It is also possible to line breed systematically for many years, thus securing the advantages of breeding from similar blood lines, while avoiding the danger of mating closely related individuals.

B. Line breeding. Line breeding is systematic inbreeding, and is designed to avoid the possible dangers arising from the miscellaneous mating of individuals which are too closely related. It is the process of carrying along the blood of a desirable individual for several generations to produce inbred strains. The close inbreeding of brother and sister is avoided

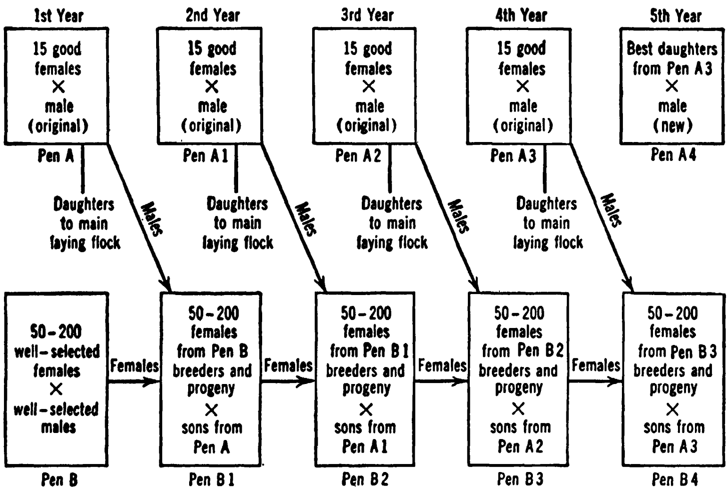
A male line may be established, starting with a fine male selected by physical examination, or one that has shown his ability to produce desirable pullets by a previous mating.

Plan 1. For the line-breeding work he may be mated with 12 or 15 females equally well selected. The daughters of this mating are placed in the laying flock. The sons of the mating are then mated to the main breeding flock. The second year the original male is mated to 12 or 15 females, part of which may be from the original pen and part his daughters or granddaughters. Sons from this pen are mated to the granddaughters and other fine females in the main flock. Should the original male die or prove inferior, he should be replaced. About the fifth generation a new male should be placed in the male producing pen.

Plan 2. It is considered a better plan by some breeders to carry two male producing pens, using the sons from these pens in alternate years on the main flock. This method reduces the danger of loss if an original male dies or is proved inferior and avoids quite as close inbreeding. When line breeding is correctly used in a flock of several hundred individuals, it will not be necessary to out-cross for many years, and a carefully bred strain can thus be established.

Plan 3 consists of a set-up like plan 2. Instead of alternating every other year as in plan 2, sons from the *A* line matings are used for 2 successive years, followed then by the use of sons from the *X* line for a similar period.

Line Breeding. Plan 1.



One special breeding pen is required each year (Pens A to A3) from which cockerels are produced for the main breeding flock (Pens B1 to B4). The daughters from Pens A to A3 matings are placed in the main laying flock each year, from which some of them may be selected to make up the fifteen selected females in each following year's special breeding pen. This practice avoids brother and sister matings, although father and daughter matings will result in some cases.

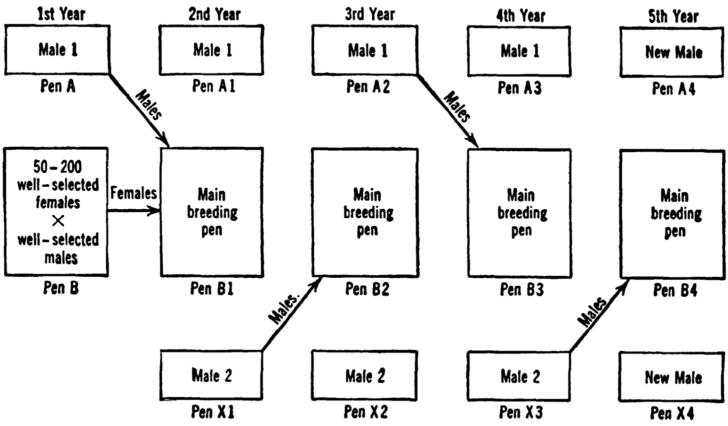
Plan 4 has the advantage of a wider choice of cockerels for the main breeding flock, should any mating prove unsatisfactory. Plan 1 gives no alternative, while plans 2 and 3 provide one alternative.

Plan 4 is similar to plan 1, except five pens are used each year, from the best of which cockerels are selected for use in the main breeding flocks. In common with the other plans, the females in the original breeding pens may be trapped and the chicks banded to determine which sire and dam lines are

most promising. The pullets from these matings may also be trapped.

Thus several months of trapnest results of sisters should be available to assist in selecting the cockerels from the best matings among the five original breeding pens the first year. The pullets are placed with the main laying flock.

Line Breeding. Plan 2.



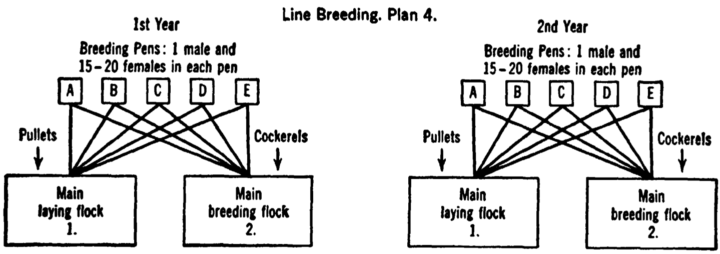
Plan 2 alternates the influence of the male. This may be an advantage if either male 1 or 2 dies or proves undesirable. The females used with males 1 and 2 are selected as in Plan 1. The daughters are always sent to the main laying flock, but may be selected in any later year as hens to enter the main male producing pens. Plan 2 provides two lines of male-producing breeders.

The second year, the best 2 males of the original 5 of the first year head pens *A* and *B*. Cockerels from these 2 males head the other three pens. The best females from the original five pens of the first year are placed in pens *A* and *B*. Females for pens *C*, *D*, and *E* are selected from the remaining birds or from the main laying flock. Avoid close inbred matings of brother and sister, father and daughter, or mother and son.

C. Out-crossing. Out-crossing consists in mating birds of the same variety but of different strains. It is occasionally

resorted to when the breeder desires to introduce new blood.

A breeder may desire to improve his strain in some characteristic and will use a male or a pen of the strain he desires, and produce males for his flock. Such a pen or male may be used in a line-breeding plan, or he may discard the male after a year or two.



Outlined by Dr. G. O. Hall, Cornell University.

1st Year

Pullets from breeding pens A to E are placed in Flock 1. Cockerels from the best of the Pens A to E are sent to Flock 2 as breeders.

2nd Year

1. Select the two best males of the first year on the basis of their progeny to head Pens A and B. Place with them the best females.
2. Use the two best cockerels from the male in Pen A to head Pens C and D, and the best cockerel from the male in Pen B to head Pen E. Place with them the best females from the breeding pens, first year, and draw the remainder from the laying flock.
3. Pullets from breeding Pens A to E are placed in Flock 1 each year.
4. Cockerels from the best of the pens A to E are sent to Flock 2 each year.
5. Avoid close inbreeding.

3rd Year

Repeat as in the second year, always selecting the two outstanding males of the preceding year to head Pens A and B.

Fertility and vigor are likely to be increased in the first generation as a result of out-crossing. Continual out-crossing is to be discouraged, as much may be lost and little gained. It is usually better to avoid mixing the blood lines of several strains.

D. Grading. The mating of a purebred male to a mongrel flock is called grading. It is frequently used to improve the

quality of a mongrel flock. Continuous grading, year after year, results in increasing the proportion of the blood of the original purebred male, and in 7 or 8 years the flock is nearly as good as a purebred one.

The process of grading up a flock is too slow, however. By securing hatching eggs or a few purebred birds, the desired end may be attained much more quickly and profitably.

E. Crossing. Crossing is the mating of indivdiuals of different breeds or varieties. Crossing certain breeds enables one to determine the sex of chicks at hatching time. The advantage is in early sex determination, high hatchability, and, in the progeny, reduced mortality, increased vigor, and desirable production. A popular cross is the Red male on the Barred Rock female. The female chicks have black heads and the male chicks show some white on their heads in about 95 per cent of the cases.

A cross which is popular with broiler growers is the Barred Rock male on Rhode Island Red or New Hampshire females. All the progeny are barred at broiler age and later.

The crosses suggested above develop into large birds and have a high value as meat when production is over.

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CHAPTER XVIII

RENEWING THE FLOCK

Operations:

1. Deciding when the flock should be renewed.
2. Deciding whether to buy or hatch chicks.
3. Deciding whether to buy sexed chicks.
4. Selecting the hen.
5. Choosing the incubator.
6. Locating the incubator.
7. Preparing the incubator room.

General information:

1. Hatching several seasons of the year.
2. Types of incubators.
   A. Small.
   B. Mammoth.
   C. Separate hatcher.

1. Deciding when the flock should be renewed

Points to consider are: (*a*) when space in the laying houses will be ready for the new pullets; (*b*) the hatching plan; (*c*) egg prices; (*d*) rearing conditions; and (*e*) breed and variety.

When pullets are hatched during the spring or normal season the flock is likely to be about one-half of the original size at the end of the first laying year. A desirable practice is to move the remaining old hens in May or June to temporary quarters or *barracks*. They will remain in barracks until sold as they cease to lay, or until moved into winter quarters to molt and start another year of laying. This releases the per-

manent quarters early in the summer for cleaning and preparing for the new flock of pullets.

Convenience or other conditions may require that all chicks be secured at the same time; in several lots during a certain season; or at different seasons of the year. See General Information 1. For small flocks the normal hatching season is best.

Highest egg prices occur during the early fall. From June or July until October, egg prices advance. Hence, one may desire to have pullets start laying during the summer and to hold the old birds in production as long as possible.

If they are to start laying in the fall, birds of the Mediterranean varieties should be hatched from February to May inclusive, in the latitude of New York State, and proportionately earlier south of this point and later north of it. American varieties should be hatched about one month earlier, and Asiatics two months earlier, than the Mediterranean varieties.

A plan with *crossbreds* extensively used in recent years is to start chicks in January. These commence laying in June and are pushed for egg production until late December when they are sold for meat. The laying quarters are then cleaned and disinfected and a new lot of chicks is started in the same quarters. However, holding these heavy birds through their first laying year is becoming more popular.

2. Deciding whether to buy or hatch chicks

Chicks of nearly any quality can be purchased, either from the breeder who hatches only from his own flock or from the hatchery which secures hatching eggs from cooperating flock owners. The cost and convenience of buying chicks have made the practice very popular.

The poultryman who has incubator space or who can buy it, and who can select from his flock the quality of breeders he desires, and who enjoys this part of the enterprise, can produce chicks at the same or a lower price than he would have to pay for similar quality. A greater investment is needed, how-

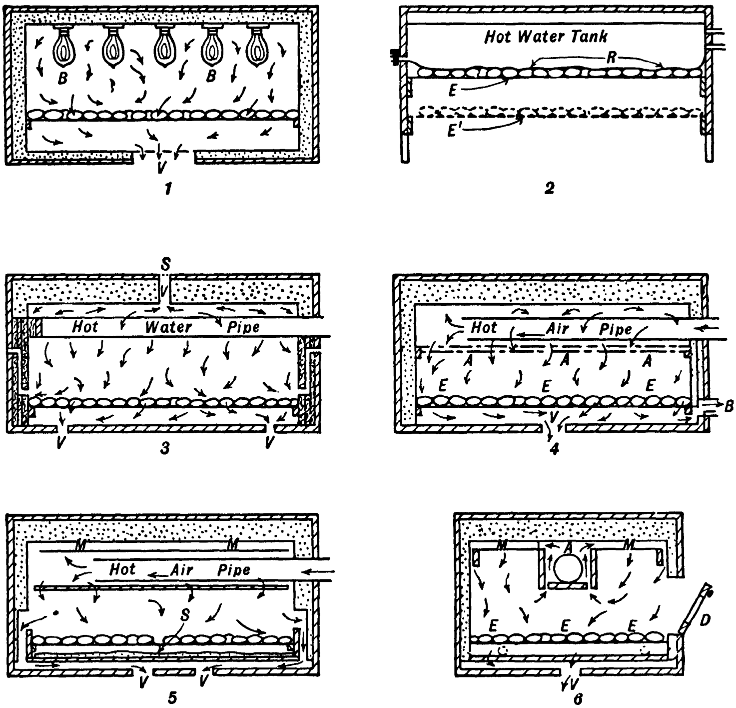

FIG. 211. Diagrams illustrating fundamental differences in heating small incubators.

1. Electric incubator, heated by radiator. *B,* Electric bulbs; *V,* ventilator.

2. Hot-water incubator, heated by contact. *E,* Eggs; *E',* position of eggs when filling tray; *R,* rubber bottom.

3. Hot-water incubator, heated by radiation. *V,* Ventilator; *S,* adjusting slide.

4. Hot-air incubator, heated by convection. *A,* Porous diaphragm through which air currents pass; *B,* return pipe to heater; *E,* eggs; *V,* ventilator.

5. Hot-air incubator (front view), heated by convection. Air currents pass over metal radiators. *V,* Ventilators; *S,* sand tray.

6. Hot-air incubator (end view). See 5 (front view). *A,* Hot-air pipe; *D,* door; *E,* eggs; *M,* metal radiator; *V,* ventilator.

ever, than if the chicks are purchased and he assumes the risk of a poor hatch.

3. Deciding whether to buy sexed chicks

If chicks are to be purchased the problem of buying straight-run, sexed, or sex-linked chicks must be decided.

Straight-run chicks include cockerels and pullets. The cockerels may be sold for meat purposes; then the remaining pullets automatically have more room.

Sexed chicks are separated into males and females at hatching time by examination of the vents by trained persons. Over 95 per cent accuracy is reached. The pullet chicks are then sold at a higher price than the straight-run chicks. The basis for figuring the price of sexed pullets is sometimes twice the straight-run price plus the cost of sexing. Chick sexers are paid ½ to 1 cent per chick sexed.

The cockerel chicks are sold at a much reduced figure. Buying sexed pullets is popular among those who do not want to bother with the cockerels, or when meat prices are low and feed is high, or when one desires to brood more chicks than the available brooders permit. (Care should be taken not to overcrowd. At 8 weeks, or before, when the cockerels would have been removed thus giving the pullets more room, the sexed pullet flock should be divided.)

Sex-linked chicks are the result of certain variety or breed crosses. Their progeny can be sorted accurately into males or females by differences in color of plumage or other characteristics. Many crosses are desirable as layers or as meat birds, but are not desirable as future breeders.

4. Selecting the hen

If one is to hatch by natural methods, the choice of the hen is important. There is as great an opportunity for choice among hens as among incubators. Select a hen in good health, of medium size, and quiet disposition, and without feathered shanks. The ideal sitting hen can be found best among Amer-

ican breeds, such as the Plymouth Rock, the Wyandotte, the Rhode Island Red, and the New Hampshire. Sitters chosen from the heavier breeds, such as the Cochin, the Brahma, and the like, are usually faithful but clumsy. Hens selected from the breeds kept especially for egg production, such as the Leghorn, the Hamburg, or the Ancona, are too small except for

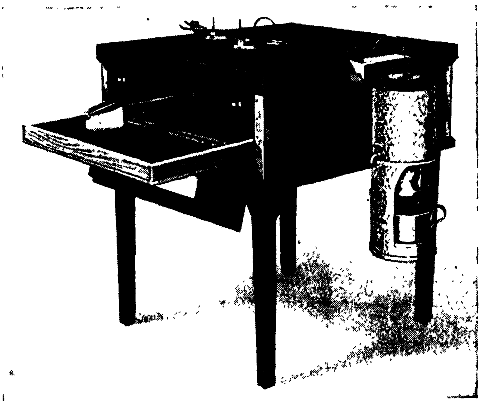

FIG. 212. A hot-water incubator, showing heater. The heated water enters the machine through pipes near the top of the machine. From Newtown Incubator Co.

hatching game eggs, and are frequently found to be untrustworthy. Very large hens, and those that are nervous and excitable, often break the eggs and sometimes injure the chicks by stepping on them. A ruffling of the feathers when approached, clucking, and use of the beak are signs of a sitter.

5. Choosing the incubator

A knowledge of the principal types of incubators is necessary to enable the poultryman to choose the one best suited to his conditions. But the experience of personally known successful users should be considered before deciding finally which type of machine to buy.

If chicks are to be purchased, an incubator will not, of

course, be needed. For a few hundred chicks a small-type machine should do. When 1500 or more chicks are to be hatched, the operator may well consider one of the larger-capacity machines. Comparative investment, available space, convenient size, labor and costs of operating, and possible future expansion should be considered.

When the business warrants selling chicks from one's own

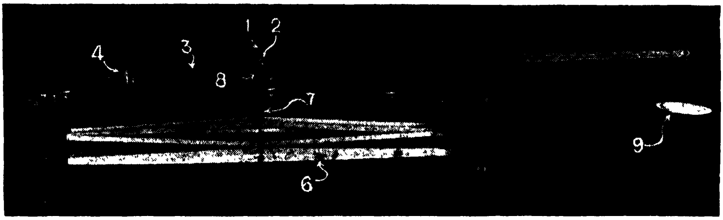

FIG. 213. A regulating device and four-bar thermostat. 1. Connecting rod; 2. adjusting nut; 3. counterpoise arm; 4. counterpoise weight; 5. regulator arm; 6. thermostat; 7. thermostat supporting rod; 8. knife edge casting; 9. disc.

flock, or a hatchery business is contemplated, the large or mammoth machines are likely to prove best adapted.

6. Locating the incubator

Still-air machines need a room temperature of about 70 degrees F. The cooler the outside room is, the greater will be the difference in temperature between the top and the bottom of the eggs in the incubator. Hatches may be spoiled by too cold or too hot air in the room. The average incubating temperature within the egg will be either too low or too high, respectively, though the temperature reading on the thermometer is correct. Hence, the more even conditions found in a basement or cellar are preferred.

Cabinet or *forced-draft machines* are less affected by room temperature than *still-air machines* because of more rapid air movement and more uniform temperature between top and bottom of the machine. Hence, rooms aboveground are more

often used. To prevent fuel loss, and to provide comfortable conditions for the operator and chicks, these rooms are often well insulated when aboveground and are kept at 70 to 75 degrees F.

A room with ceiling 3 feet or more above the top of small incubators and having windows near the ceiling for ventilation

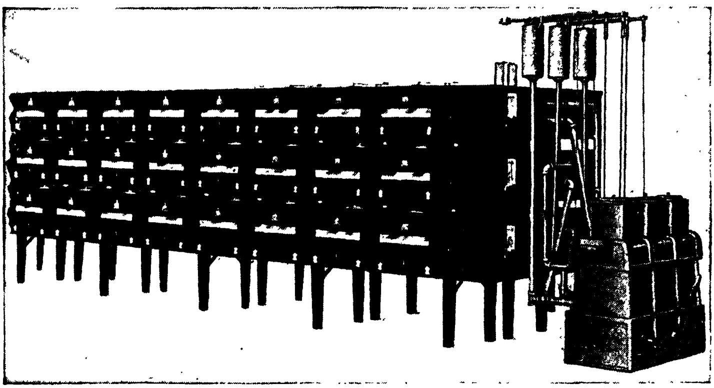

FIG. 214. A triple-deck hot-water mammoth incubator. Each deck is heated and regulated independently and supplemented by individual compartment regulation and ventilation. From Newtown Incubator Co.

is desirable. The windows may be sliding or tip-in types. Air should enter and leave the room without blowing on the incubators. Curtains should prevent the sun from shining on the incubators.

Dimensions governing the size and ventilation of rooms for mammoth incubators vary with the size and type of machine. Directions should be obtained from the manufacturers of the machine in which one is interested and they should be followed carefully.

The type of incubator will govern its place in the room. Small incubators and cabinet-type mammoth incubators are often placed a foot or two from the wall, while sectional types which open on both sides must permit handling the trays between the wall and the machine.

7. Preparing the incubator room

In addition to having the incubator in place, and the various items of equipment checked, the room should be cleaned and disinfected, and the windows cleaned and arranged for easy adjustment.

The next step is hatching the eggs (Chapter XIX).

GENERAL INFORMATION

1. Hatching several seasons of the year

The idea of hatching during the spring has so long prevailed that with some it has become a custom not to be disputed. However, the increasing demand for chicks at other seasons, the introduction of better-controlled incubators, and the newer knowledge of feeding and breeding for hatchability and growth have given rise to the practice of hatching the year around.

The hen and the native birds which are forced to do their sitting at a time when food is abundant for both sitter and young work under different conditions from the modern poultryman. He, through scientific discoveries, has learned how to supply necessary feed ingredients to both old and young stock at other than the spring season. Better knowledge of chick disease control has also helped to remove the risk.

In a normal laying flock, mortality and culling gradually reduce the number of birds. This varies in different flocks. An average percentage might be: during 4 months of laying, 8 per cent; during the next 4 months, 8 per cent, during the third 4 months, 34 per cent, and during the first 4 months of the second laying year, about 16 per cent.

By using the records from one's own flock a plan for hatching may be formulated so that pullets will be ready to place in the laying houses two or more times during the year, thus bringing the flock back to its original size. Less brooding equipment is needed and the flock may be held to not less than

three-fourths of its original size instead of one-half, as is often the case.

Figures from one successful farm show the following results:

Hatches	Start Production	Average Production per Hen	Production During Sept., Oct., Nov.
May	October	204	50
July	December	203	52
November	April	196	50
January	July	192	51

Comments accompanying these results:

1. Heat was not used on any hatch after 8 weeks.
2. Chicks were allowed out of doors at will after 5 weeks.
3. Hatchability was slightly poorer during the summer.
4. Pullets hatched in June, July, August, and September take 3 to 4 weeks longer to reach sexual maturity. They start laying larger eggs.
5. There is no difference in brooding or rearing mortality. (Reared in colony houses.)
6. No significant difference in adult mortality.

Advantages in hatching during several seasons of the year are: less brooding equipment needed and more efficient use of it, house capacity better utilized, production more uniform over the year, more chicks from the same breeders and better yearly labor distribution.

2. Types of incubators

Incubators can be roughly classified as: (*a*) hot-water radiation from pipes in the egg chamber; (*b*) hot-air infusion, or warm air pouring directly into the egg chamber; (*c*) hot-air diffusion, or warm air passing through a diaphragm; and (*d*) forced-draft, where the air is driven by fans or agitated by paddles.

A. Small incubators can be divided also into moisture and non-moisture types. One moisture type is equipped with a

tray of sand in the bottom, which is kept wet. The moisture prevents excessive evaporation of the eggs while the air is continually changing within the machine. The non-moisture type

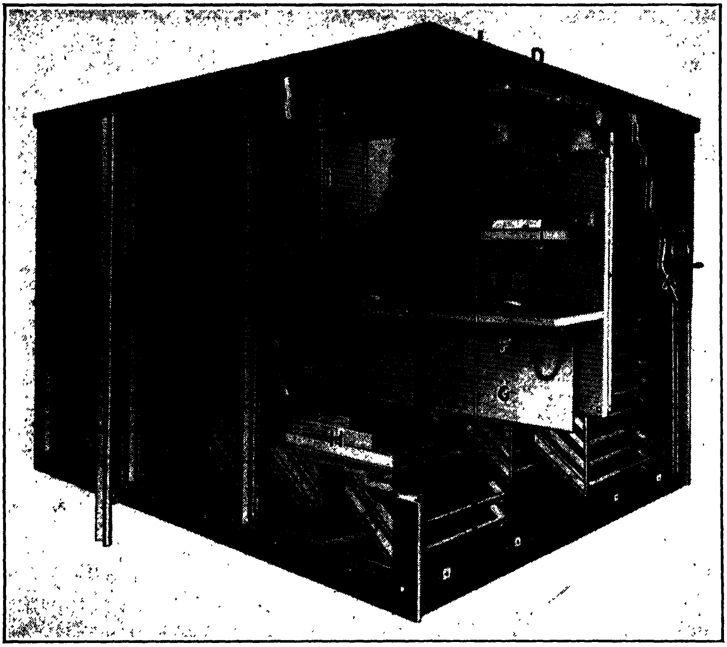

FIG. 215. A mammoth forced-draft type incubator (setting unit). Separate hatching units required. *A*, Careful insulation; *B*, 15 egg trays in each stack; *C*, egg turning apparatus; *D*, fixed ventilators in top and end; *E*, ball-bearing circular fans push the air to the floor and up through the egg trays; *F*, low-intensity, open-coil type electric heaters; *G*, baffle plates for dividing and directing the air; *H*, automatic humidifier; *I*, double long-tube control and safety thermostats; *J*, humidity control; *K*, long-stem temperature thermometer and special wet-bulb thermometer to be read outside the machine. Courtesy Buckeye Incubator Co.

reheats and redistributes the air, thus reducing the change of air and preventing excessive drying of the eggs.

Heat may be supplied by kerosene, gas, or electricity.

Incubators are available having capacities of 50 to several hundred eggs.

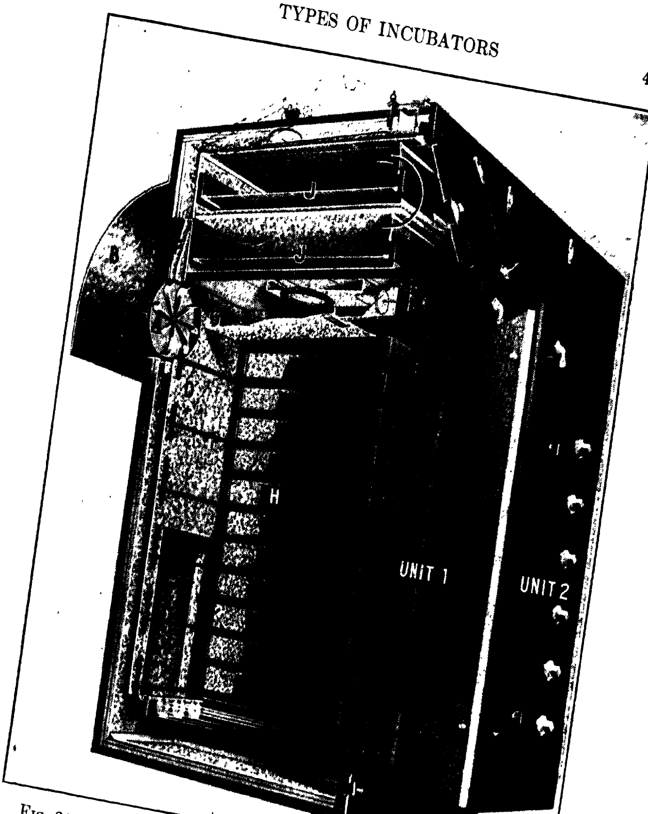

FIG. 216. Phantom view of the Jamesway 2940 incubator hatcher.

A forced-draft type. Two units are shown. The interior of all units are like Unit 1. Each unit is separate except that the turning mechanism operates the full length of the machine. Each of the six turning gears (extreme right) turns two trays of eggs throughout the length of the machine, even though they are separate units. Known as a twice-a-week hatcher, two trays are set each 3½ days, the two-tray hatching compartment *J* operating twice weekly after hatching commences.

AIR CIRCULATION

The fan *A* and motor *C* are enclosed in an airtight hood *B*. The baffle sheet *D* forms air channels *E* and *F* leading down to the bottom of the incubating chamber *H* and up into the hatching chamber *J* respectively. Air is drawn into the machine through tube intakes *G* by fan suction, mixed with the air in the incubating chamber by the fan and forced into channels *E* and *F*. Circulation and recirculation of the air among the trays in *H* occur. The air exhaust at *I*, lower right, is controlled by hand. Air in the hatching compartments *J* passes from the lower to the upper trays, through a down collector, and out of an exhaust at the top of the machine. Courtesy The Jamesway Incubator Co.

In addition to the well insulated wall, the heater, the ventilation and moisture systems, and the egg chamber, the regulating device or thermostat is a vital part. In kerosene- and gas-heated incubators, as the heat expands the thermostat, the latter pulls down on the connecting rod, raises the disc, and thus allows the surplus heat to escape. As the amount of heat decreases, the thermostat contracts, allowing the disc to drop down on the heater, thus directing more heat into the machine.

In electric incubators the current is turned on or off, as the case may be, thus supplying heat only when needed.

B. Mammoth incubators. The small incubator was the stepping stone from hen-hatching to the deck and then to the cabinet machines. The coming of mammoth incubators not only enabled the breeder to incubate several thousand eggs with greater economy, and to diversify his business by selling baby chicks, but it gave rise to the important hatchery industry.

Mammoth incubators can be divided into the sectional and cabinet types.

The *sectional* type is a long machine consisting of several sections, which may be added to or removed from the machine as required. Later types followed the same principle, but added the double- and triple-deck idea, as more hatching space was needed (Fig. 214). Water is heated by coal, oil, or gas and distributed in pipes. Although more compact than the same capacity in small machines, a long, wide room is required. There are also many different units to regulate and clean.

The *cabinet* type is a compact room (Fig. 215). Eggs are placed in trays from the top to the bottom of the machine. The temperature is evenly distributed through the entire machine either by paddles or fans; hence, the name "forced-draft" machines. The machines can be placed in almost any part of the room that is most convenient for the operator. It is easier to heat one large room than many small rooms, and there is less wall area; and, hence, less exposed area per given number of eggs.

Cabinet-type machines are heated with coal, oil, gas, or electricity. When electric current is dependable, it is most often used.

Most of the modern forced-draft, cabinet-type incubators provide humidity control by spraying water into the machines

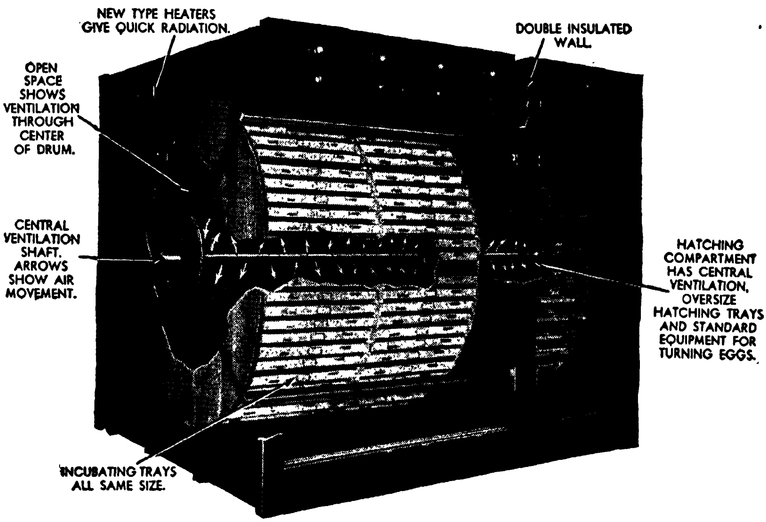

FIG. 217. Petersime Hatchibator. Open view of the Model 20 Petersime Hatchibator. This type provides a breathing air movement. The air entering the central ventilation shaft is stirred by the rotation of the four-bladed reel as it moves slowly around the egg drum, mixing moisture with the warm air and equalizing the temperature. As the blades move down on one side, other blades move up on the other side. The greatest air pressure is on the lower side of the one blade and on the top side of the other. This causes a push-pull air movement through the entire compartment. Courtesy of The Petersime Incubator Co.

or by passing humidified air into the machines and determining relative humidity by the use of wet-bulb hygrometers.

C. Separate hatching-compartment machines. This feature provides units for incubation up to the eighteenth day inclusive, and separate units for hatching, thus permitting a slightly lower temperature from the eighteenth day. It also

permits the two compartments to be fumigated or disinfected separately. In the deck-type machine the separate hatching compartment is less necessary since no other eggs are involved at hatching time. With a machine in which all stages of incubation including hatching are in one compartment, it is necessary to fumigate and disinfect the machine while all the stages of incubation and hatching are in progress.

COMMUNITY SURVEY

1. At what date does incubation of eggs begin in your locality?
2. What makes of small incubators are in use near by?
3. What makes of mammoth incubators are in use near by?
4. Sketch one of the best incubator cellars near by and list the favorable points, as given by the owner or operator.
5. Are there any poultrymen starting chicks at other than the spring season?
6. If so, when?
7. Why are they doing this?
8. What hatching season gives the best pullets for laying purposes?
9. Ask one or more poultrymen how they figure the number of pullets they will need in a year.
10. What percentage of the poultrymen hatch their own chicks?
11. What percentage of the poultrymen buy their chicks?
12. Do any of the poultrymen buy sexed chicks? Why do they get them?
13. Are crossbred chickens grown?
14. When are crossbred chickens hatched? How long are they kept as layers?

CHAPTER XIX

HATCHING THE EGGS

The process of incubation, by which, in the space of 3 weeks, a microscopic germ is changed into a downy chick, capable of walking, eating, and expressing its needs by its voice and actions, seems nearly magical. With such rapid development and change within the egg (see Chapter XX), great care must be exercised to provide correct conditions if a good percentage of strong chicks is to be hatched. No detail should be overlooked in giving the egg every chance to hatch, and each chick a chance to live, since upon their ability to do this may rest the success or failure of the poultry enterprise.

Operations:

1. Selecting hatching eggs.
2. Caring for hatching eggs.
3. Testing the thermometer.
4. Preparing the small incubator.
5. Preparing the mammoth incubator.
6. Starting the hatch.
7. Maintaining the proper temperature.
8. Maintaining the proper humidity.
9. Turning the eggs.
10. Ventilating the machine.
11. Cooling the eggs.
12. Testing the eggs.
13. Taking off the hatch.
14. Cleaning and disinfecting.
15. Hatching with hens.
16. Pedigree hatching.

1. Selecting hatching eggs

Each egg is a potential chick. We desire it to be fertile, to hatch a chick that will live and grow into a desirable meat bird, or into a pullet that will produce the right kind of market eggs. Breeding plays an important part. The breeders having laid the eggs, our job is to select the best eggs we can.

Select eggs that are uniform in size, shape, and color, that have strong shells, and that weigh about 2 to 2⅓ ounces each or 24 to 28 ounces to the dozen. Abnormally large or small eggs (over 30 or under 23 ounces to the dozen) should not be used.

Certain eggs that are undesirable in size, shape, and color from a marketing standpoint may hatch well, but should not be used, because the resulting pullet is very likely to produce the same undesirable type of egg. Everyone selecting eggs for hatching should remember that careful sorting for incubation means less sorting of eggs from the resulting pullets and a higher price for market eggs, and offers an opportunity for efficient management that should not be overlooked.

This selection should be preceded by selecting breeders, if possible. The average size, shape, and color of eggs laid by any breeder is a fair measure of the eggs her daughters will lay.

2. Caring for hatching eggs

If the best results are to be obtained, several points should be observed in the handling of eggs for incubation from the time they are laid until they are set.

A. Gathering the eggs. Collect hatching eggs at least three times daily, to protect them from extreme heat or cold.

B. Producing clean hatching eggs. Clean eggs are best for hatching. If the eggs are very dirty, bacteria are likely to have gained access to the inside of the egg, with harmful results.

C. Holding the eggs. A summary of research and practical experience indicates:

(1) Avoid holding hatching eggs for long periods below 40 degrees F.

(2) Temperatures above 60 degrees F. for long periods are. not desirable.

(3) 50 to 60 degrees F. is a fairly safe range under most conditions.

(4) Ten days appear to be the time limit for holding, with 2 weeks the apparent maximum. Seven days or less is preferable.

(5) High rather than low relative humidity is preferred; 75 to 85 per cent appears desirable.

(6) Eggs held longer than 1 week should be turned.

(7) Pre-heating eggs during the holding period is of doubtful advantage.

(8) Hatchability appears to depend more on the condition of the embryo than upon the interior market quality of the egg.

(9) Prolific layers and birds coming into production produce more hatchable eggs than birds producing at a low rate. A period of 25 to 27 hours between eggs from individual hens results in better hatchability. Embryos withstand holding better after the gastrulation stage is reached, and before the primitive streak forms. The former is usually reached before the egg is laid, the latter during the first few hours of incubation.

(10) Chick embryos should not be held long under conditions permitting inefficient metabolism. Either start incubation at once after the egg is laid or reduce metabolism to practically a dormant stage, but do not entirely eliminate it. A temperature of 50 to 60 degrees F. appears to accomplish this. Between 60 degrees F. and incubation temperatures, the embryo may use some of the essential factors while others requiring higher temperatures may be metabolized inefficiently, with resultant permanent injury to the embryo.

(11) It is likely that eggs placed in incubators directly from the cool holding room reach a stage of efficient metabolism more quickly and with more favorable results.

FIG. 218. Forced-draft incubators on the ground floor. The packing and sorting room is in the distance.

(12) A good egg room is a cellar or well insulated room, protected from the warm, dry outside air, ventilated, supplied with a method of controlling moisture and temperature, located conveniently, and containing equipment necessary to do the work efficiently.

3. Testing the thermometer

Test the thermometers each season to make certain that they register accurately. Secure a thermometer known to be correct, such as a physician's clinical thermometer, and hold it near the one to be tested. Rotate both in water at about 103 degrees F. If there is any difference between the readings of the two thermometers, make a distinct mark that cannot be misunderstood on the incubator thermometer, in order to make a correction when using it.

4. Preparing the small incubator

Clean and disinfect with a 2 or 3 per cent solution (preferably in hot water) of a cresol disinfectant (3 ounces of the compound to 1 gallon of water). Do this even though the machine has been thoroughly cleaned at the close of the previous season, as it should have been. After brushing out the remains of the previous hatch, if any, use a sprayer or a scrubbing brush, and saturate the interior of the machine. Clean the heater with a brush or a piece of cloth on a stick. If the isinglass in the heater is dirty, clean with a cloth dampened in vinegar. See that the lamp is clean and the burner and gauze free of foreign material. Level the machine. Renew the wick after each hatch, to avoid danger of its being too short to reach the oil at any time during the hatch.

5. Preparing the mammoth incubator

All parts of the machine must be in working order. Sectional machines will need to be started, thermostats checked, compartments cleaned and disinfected, if necessary, and the heater carefully examined. After the eggs are in, it is too late to find the equipment in need of repair.

Cabinet machine motors must be oiled, pilot lights checked, and the heater, air distributors, moisture apparatus, and electrical connections made ready.

6. Starting the hatch

Eggs may lie on the tray on their side or on end, with the large end up. They should never be placed with the small end up. Eggs may be placed on the incubator trays as they are brought to the egg room, or just before they go into the incubator.

Placing cold eggs in the machine lowers the temperature. From 10 to 12 hours is usually required to warm the eggs through and restore the desired temperature in the egg chamber in *still-air* machines. In the *forced-draft* incubators, readjustments in the temperature take place more quickly. The

temperature may drop 3 to 4 degrees, but will regain the normal point again in 3 to 4 hours. Eggs are sometimes held in a room at 70 degrees F. for several hours before they are placed in the machine. This practice makes the change in temperature more gradual and requires less time for the machine to warm the eggs, but it is not considered the best practice.

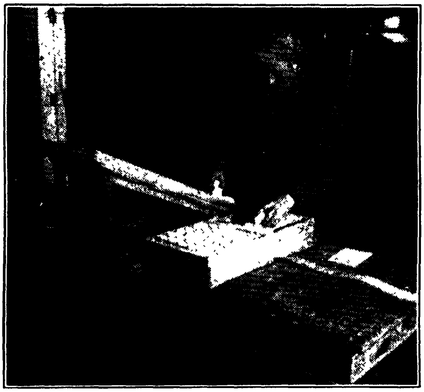

FIG. 219. Traying eggs. Eggs are removed from the case, into which they were sorted, and are placed on the incubator trays small end down.

Higher temperatures result in earlier hatches and lower temperatures in later hatches. If the eggs are not pre-warmed and the *still-air* incubator is set at night, the next day is called the first day of incubation. The hatch should be complete the morning of the twenty-second day. Pre-warming the eggs may advance the hatching time slightly.

In *forced-draft* incubators, which include both eggs and hatching chicks in the same room, pre-warmed eggs in at 7 A.M. on the first day should complete the hatch the morning of the twenty-second day.

7. Maintaining the proper temperature

Small or *sectional incubators.* The egg chamber is warmest near the top and coolest near the bottom. A hanging thermometer or one with the bulb above the eggs should regis-

ter higher than a contact thermometer or one with the bulb on a level with the eggs.

Temperatures should be about as follows, for still-air machines:

Hanging or Standing Thermometer

First week	102.5 to 103 degrees F.
Second and third weeks	102 degrees F.
18th day to end of hatch	100 to 101 degrees F.

Fig. 220. The trays of hatching eggs are placed in the incubator.

Cabinet mammoth or *forced-draft incubators.* The temperatures vary in different machines. When hatching is done in the same machine where eggs are being incubated, the temperature cannot be lowered at hatching time because of the harmful effects on the eggs. Such machines are kept constantly at about 99½ degrees F., unless otherwise specified by the manufacturer, because of the location of the thermometer.

When eggs are transferred to the *separate hatcher* the temperature *to the eighteenth day* is 99.5 to 100 degrees F., dropping the eighteenth day to 98 to 99 degrees F.

8. Maintaining the proper humidity

The relative humidity should be the same in all types of incubators, namely about 60 per cent. However, for best results it should be 55 per cent to the eighteenth day and

increased 5 to 10 per cent from the eighteenth day until the end of the hatch.

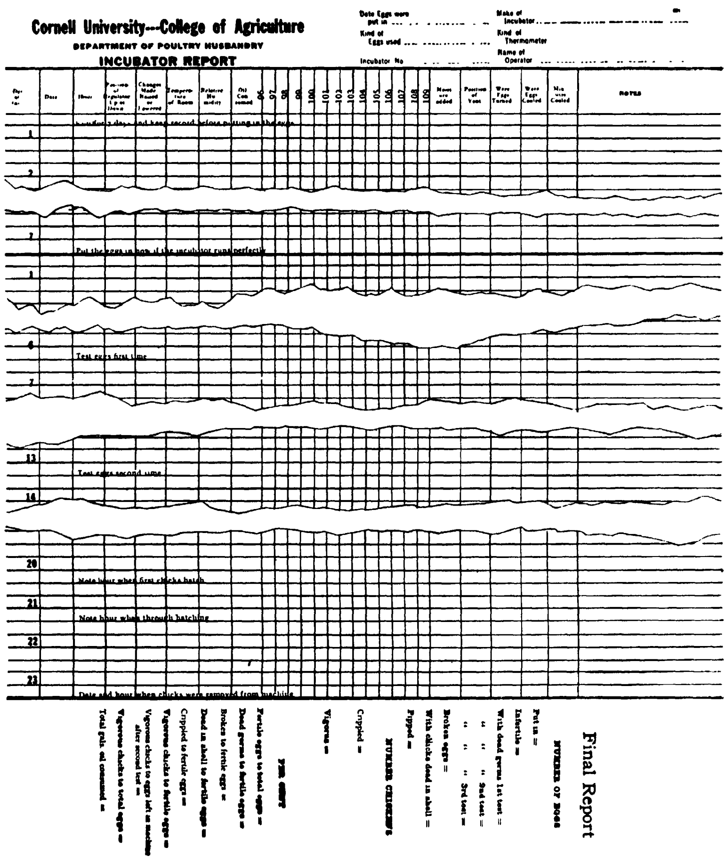

FIG. 221. Incubator record sheet for student or commercial work with small machines. The temperature curve may be plotted as the period progresses.

In *still-air machines* the reading could be made by a reliable hair hygrometer, while in *forced-draft machines* the wet-bulb reading could be made. In the latter case the reading

should be 84 to 86 degrees F., and 88 degrees F. from the eighteenth day to hatching time. If the machine is fumigated, the wet-bulb reading should be 90 degrees F., thus increasing the relative humidity to 65 or 68 per cent. (See page 414.) The high humidity assists the action of the fumigant and reduces the spread of dust in the machine.

In order to insure accurate wet-bulb readings, there must be rapid circulation of air. This is impossible to secure in still-air machines. The hair hygrometers may be used in the still-air machines. They are fairly accurate when the hair is long enough. The hygrometer should be at least 4 inches in diameter. Metal spring hygrometers are less accurate.

The wet bulb is contrived by covering the bulb with a muslin or silk wick, one end of which is inserted into a cup of water. If there is an absence of moisture in the egg chamber, the evaporation of moisture from the wick around the bulb increases. Since the evaporation is a cooling process, a lower reading results. The higher the humidity in the egg chamber, the slower will be the evaporation and therefore the higher the reading.

To increase the moisture in the outside air, the floor should be kept damp. Incubators that are equipped with moisture pans or troughs should receive water in accordance with the manufacturer's directions unless this method has been given a fair trial and found unsuited to the prevailing climatic conditions.

Statement on the Question of Moisture and Temperature [1]

What is humidity? Humidity is the moistness of air. Also, technically speaking, humidity is saturation of atmospheric air with water in form of vapor. When we use terms

[1] Alexis L. Romanoff and Royal A. Sullivan, Laboratory of Experimental Embryology, Cornell University Agricultural Experiment Station, Ithaca, N. Y.

"high humidity" or "low humidity" of air we mean that the air holds relatively large or small amounts of water.

How humidity is measured in the incubator. Humidity is measured by the comparison of a given humidity condition

WET-BULB READINGS AT VARIOUS RELATIVE HUMIDITIES AND TEMPERATURES

(Calculated for average atmospheric pressure of 29 in.)*

Relative humidity (per cent)	Temperatures								
	99.0	99.5	100.0	100.5	101.0	101.5	102.0	102.5	103.0
	Wet-bulb readings (degrees F.)								
40	78.2	78.6	79.0	79.4	79.8	80.3	80.7	81.1	81.6
45	80.5	80.9	81.3	81.8	82.2	82.6	83.0	83.3	83.7
50	82.5	82.9	83.3	83.8	84.2	84.6	85.0	85.4	85.8
55	84.5	84.9	85.3	85.8	86.2	86.6	87.0	87.4	87.8
60	86.4	86.9	87.3	87.8	88.2	88.6	89.0	89.4	89.8
65	88.2	88.6	89.0	89.5	90.0	90.5	91.0	91.4	91.8
70	89.8	90.3	90.7	91.2	91.7	92.2	92.7	93.1	93.5
75	91.5	91.9	92.3	92.8	93.3	93.8	94.3	94.8	95.3
80	93.2	93.6	94.0	94.5	95.0	95.5	96.0	96.5	97.0

* Prepared by Alexis L. Romanoff and Royal L. Sullivan, Cornell University.

with the condition of air when it is fully saturated. Full saturation of air is taken as 100 per cent. One-half saturation, therefore, would be equivalent to 50 per cent, or so-called relative humidity. One-quarter saturation would be equivalent to 25 per cent relative humidity, and so forth. In practice, humidity of air is determined either by direct reading with the aid of a hair hygrometer or indirect reading from the differences in readings of wet- and dry-bulb thermometers. The

actual readings of wet-bulb thermometers at various temperatures and humidities are shown in the table.

What is the relation between humidity and temperature? The higher the temperature is, the greater the amount of water at full saturation of moisture in the air. And the lower the temperature is, the smaller the amount of water at full saturation. Therefore, air at 50 per cent relative humidity and high temperature would contain a proportionately larger amount of water than air at 50 per cent relative humidity and low temperature. This relation between the temperature and the holding capacity of air for water is shown on page 414.

9. Turning the eggs

Turn the eggs three to four times daily, from the first to the eighteenth day of incubation inclusive. Turning is very beneficial. The hen turns her eggs several times during the day and night.

Most modern machines are equipped with quick turning devices which work without removing the eggs. It is not necessary to turn the eggs completely over. When turning by hand with small machines, if the trays are full, remove a few eggs, and with the palms of the hands shuffle the eggs back and forth until all have been moved. Also, turn the trays end for end one time and from side to side the next, if the compartments hold more than one tray. This practice helps place all eggs under any different temperatures that may exist in the egg chamber.

10. Ventilating the machine

Follow the manufacturer's directions carefully. Oxygen is an important element. The embryo uses about ¼ cubic foot of oxygen (O_2) during incubation and produces about ¼ cubic foot of carbon dioxide (CO_2). The amount of each is small at first, increasing gradually until toward the end of the period the exchange of gases is considerable. The chick is very sensitive to CO_2.

During the entire period of incubation it is well not to exceed 0.5 per cent of CO_2.

Still-air machines need more ventilation near the end of the hatch.

Mammoth machines of the forced-draft type have the air well equalized and no excess of CO_2.

11. Cooling the eggs

Experiments indicate that special cooling is unnecessary, except if the eggs should become overheated.

12. Testing the eggs

Dead embryos give off harmful gases. In *forced-draft* machines these gases are easily driven away and, hence, it is

FIG. 222. Testing incubator eggs. This tester is made to use with the incubator lamp in a dark room when electricity is not available. See Figs. 137 and 138.

not necessary to test and remove them. However, some operators do so on the eighteenth day while changing the eggs to the separate hatcher or earlier to conserve space. It is customary in *still-air* machines to test twice; white eggs on the fifth or sixth day and brown eggs on the seventh or eighth day. Both are again tested on the fourteenth day. Best results in

testing are secured if the room is darkened. Hold the eggs before the tester with the large end up (Fig. 222). A position about 12 inches in front of and below the eye makes it easier to see the contents. Give the egg a gentle turn and the contents will move. If the egg is infertile, the yolk will appear as a dark shadow moving with the egg. The air cell will be considerably larger than that in a fresh egg.

FIG. 223. If the chicks are to be moved a long distance or shipped, boxes similar to these are satisfactory. Note the strips of wood on the lid, thus allowing the boxes to be piled up without shutting off circulation of air about them.

The fertile egg, at the first test, will have a darkened spot on the yolk, with several red blood vessels radiating from it, resembling a spider. The larger and more distinct the embryo appears, the stronger is the germ.

If the germ appears without the radiating blood vessels, and with a whole or partial ring of blood around it, the germ is dead and the egg should be removed.

At the second test, on or about the fourteenth day, remove any eggs in which the germs have died since the first test. In an egg that contains a live germ large blood vessels are usually seen near the air cell, and frequently the chick is seen to move. Eggs having a dark center, with a clear area near the edges, are probably dead embryos. The beginner should break open several eggs that appear dead at this test, in order to check up on his judgment.

13. Taking off the hatch

Still-air machines. When dry, the chicks may drop into a nursery below the tray or be hardened by lowering the temperature slightly or by opening the incubator door about one-eighth inch and fastening it.

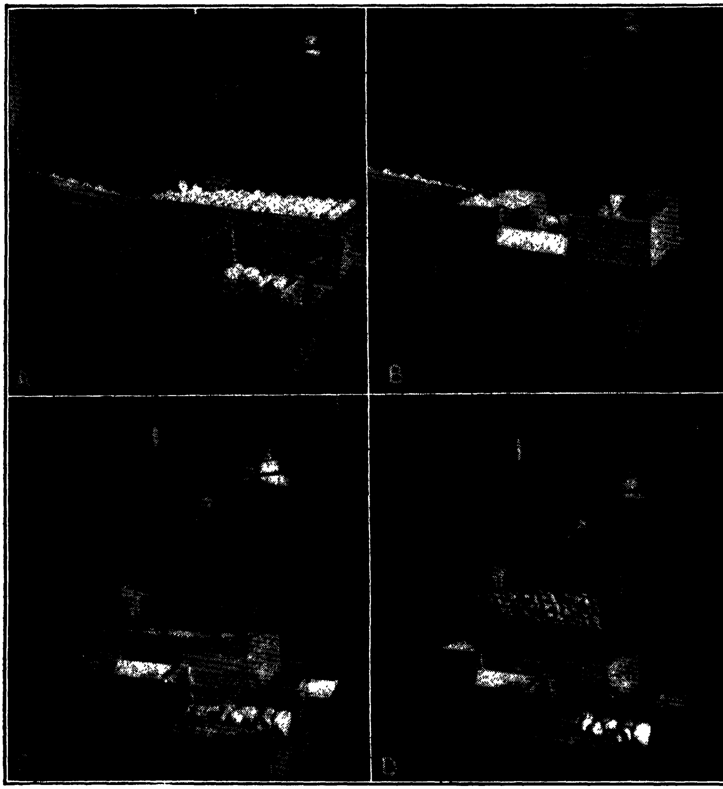

FIG. 224. Testing eggs from a mammoth incubator. Four steps in testing and removing eggs to the separate hatcher tray. *A*. Wire bottom tray of eggs over the tester box. Removing infertiles and replacing from a second tray. *B*. The tester box with light bulbs in place. *C*. Placing the hatcher tray over the original tray. The special crepe paper is laid on first and will push into place at the bottom of the hatcher tray. *D*. Hatcher tray has been pushed down over the original tray, the trays are being turned, after which the original tray will be lifted out, the eggs rolled or turned to lie on their sides or with large end up, and the new tray with its eggs placed in the separate hatcher.

Forced-draft machines permit the chicks to remain in the hatching trays until all are dry. The chicks are then either sorted directly from the trays to boxes, or baskets, and carried to brooders, or they may be counted from the hatching trays into boxes, carried to the sorting table, and boxed for the brooders or for sale, as the case may be.

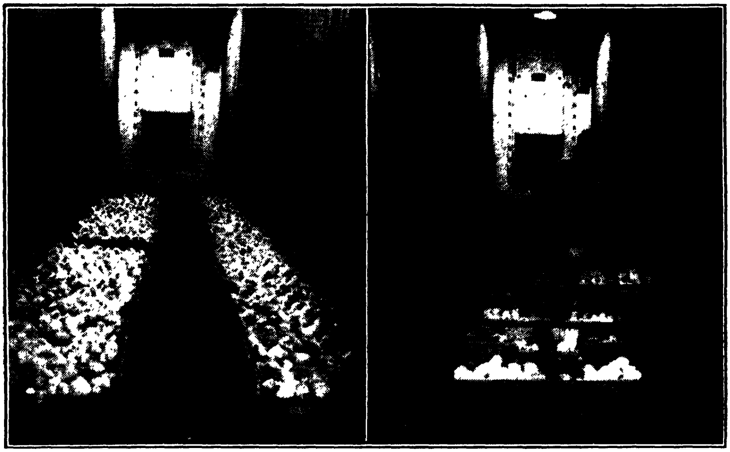

FIG. 225. Left: Part of a good hatch in a mammoth room type machine. *Right:* Transferring chicks from the hatching trays to boxes, later to be sorted.

Caution: When chicks are removed from the incubator, there is danger of chilling, especially if they are not thoroughly dried.

14. Cleaning and disinfecting

The practice of fumigating either just before, during the time chicks are hatching, or afterward has become general. Manufacturers of incubators have prepared directions for fumigation of their particular machines at these periods.

Plan 1. Forced draft. Determine the cubic feet of incubator space. For each 100 cubic feet use 20 cubic centimeters

FIG. 226. Sorting chicks into boxes for brooders or for sale.

FIG. 227. Sexing chicks in a commercial hatchery. Organized companies provide sexers who work at a certain rate per chick.

(⅔ ounce) of formalin. Cut a piece of cheesecloth, approximately 1 yard for each fan, soak in the formalin, and hang under the fans. The cloth may be partially twisted and suspended by the ends to hooks so that it hangs loosely. Fumigation is started when there are a few chicks on the trays and

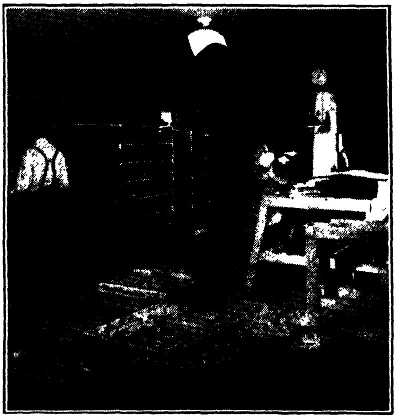

FIG. 228. The sorting and sexing room, with several thousand chicks ready to be shipped.

repeated every 12 hours until the hatch is finished. The wet-bulb reading should be about 90 degrees F.

After the chicks are removed, the floor is cleaned with a vacuum cleaner, the trays brushed clean with a wire brush, and returned to the incubator.

The shells and unhatched eggs are taken to a dump.

Plan 2. When the eggs are transferred to the separate hatcher, measure out the potassium permanganate crystals into a jar or crock. Add the formalin. Place in the machine and close the door. Leave at least 30 minutes.

"A simple way to determine the required amounts of chemicals is to use the following chart:

Cubic Feet of Air Space	Amount of Formalin	Amount of Potassium Permanganate
10	1 teaspoonful	½ teaspoonful
20	2 teaspoonfuls	1 teaspoonful
50	5 teaspoonfuls	1½ teaspoonfuls
100	¼ cup	⅛ cup
200	½ cup	¼ cup
400	1 cup	½ cup

"The chemicals are combined in a wide-mouthed earthen- or enameled-ware jar. The jar should be large enough to hold

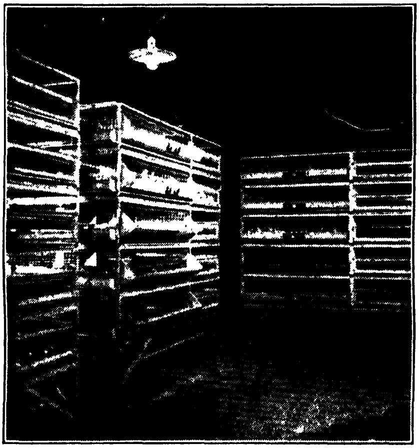

Fig. 229. The battery room in a commercial hatchery. Surplus chicks are often held in batteries for a few days until sold.

at least ten times the amount of chemicals placed in it, so that the chemicals will not boil out over the jar." [1]

For fumigating *still-air* compartments after the hatch is completed, clean thoroughly, determine the amounts of chemi-

[1] E. L. Brunett, "Poultry Diseases," Cornell Extension Bulletin 377, 1939.

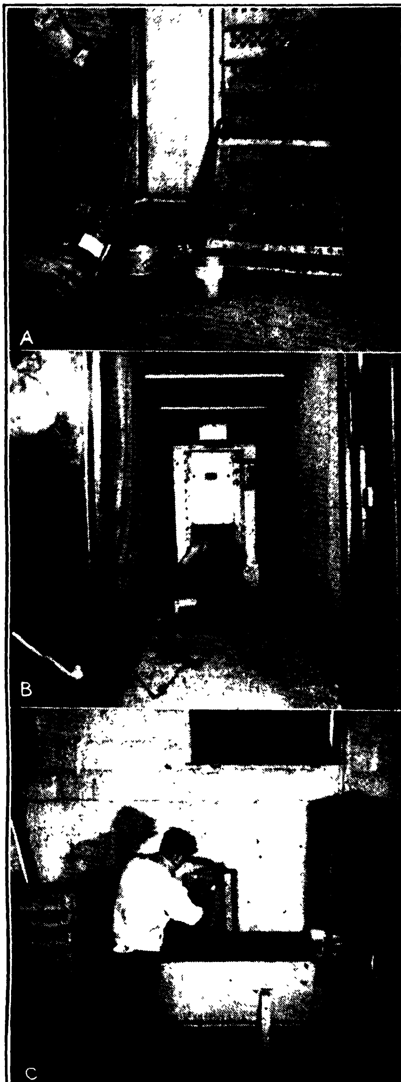

Fig. 230.

A. Fumigating with formalin and potassium permanganate in the separate hatcher on the eighteenth day. The mixture is placed in the container, which is then put onto the floor of the machine. *B*. Cleaning the floor of a mammoth room type incubator after the hatch. *C*. Disinfecting incubator trays.

cals needed (use above table), place in the machine, and leave for 30 minutes.

"The air in the compartment must be warm and moist before the fumigant is placed. The dry-bulb reading should be between 99 degrees and 100 degrees F. and the hair hygrometer reading should be around 68 per cent relative humidity. Moisture and temperature play an important part in determining the efficiency of the gas."[1] Remove the hygrometer while fumigating.

After the hatch, clean out the interior and disinfect the compartment and the trays.

15. Hatching with hens

Making the nest. The general requirements of a nest are that it be roomy, cool, well ventilated, protected from enemies, sanitary, secluded, and safe for the newly hatched chicks. The nest should be 12 to 16 inches square and a few inches deep. A good nest can be made by removing the bottom from a dry-goods box and placing it on the ground or floor in a secluded corner of some building or shed.

Coops are used out of doors for one or more hens. In any case the hen may be given freedom to the extent of a small yard, which should be shady. The nesting material used when setting hens is generally oat straw, wheat straw, fine hay, cut straw, or clean chaff, placed on a sod or several inches of moist earth and packed well into the corners and hollowed in the center to hold the eggs.

Setting the hen. When a good sitter is found, she should be gently transferred to the hatching room or hatching coops.

The transfer should be made at night. The hen should be thoroughly dusted with a good lice powder, and this dusting should be repeated 3 or 4 days before the eggs hatch.

It is well to set the hen on several eggs that are not to be

[1] E. L. Brunett, "Poultry Diseases," Cornell Extension Bulletin 377, 1939.

used for hatching, until she becomes accustomed to her surroundings. If she does not leave the nest except for food or for water during the following day, it is generally safe to place the eggs for hatching under her the following night. The number of eggs to be set will depend upon the size of the hen and the weather conditions, and will usually range from 12 to 15 eggs in early spring, and 2 or 3 more during warmer weather.

Feeding the hen. During the entire hatching period, feed the hen once daily with grain only. In addition, plenty of fresh water and a small amount of grit should be supplied. Do not give wet and dry mashes or cooked and sloppy feeds.

Important details. If eggs are broken in the nest, they should be removed at once and fresh nesting material supplied. If the remaining eggs are smeared, they should be washed with warm water.

At the end of the first and second weeks, the eggs should be tested and those that are infertile or contain dead germs should be removed. If several hens are set at the same time, the eggs from two hens may often be placed under one after the undesirable eggs have been removed. The extra hens may then be set again or placed in a special coop for breaking up broody hens. Sitting hens should be looked after daily, especially if they show a tendency to stay off the nest too long.

Care at hatching time. If the hen becomes restless, it may be necessary either to confine her or to remove some of the chicks. If the latter is done, the chicks can either be given to a hen that has completed hatching or held in a warm box for a few hours. When the chicks are 36 hours old, they may be transferred from the nest to the outdoor brooder coop. The nest should be cleaned, and the litter burned; if the nest box is to be used again, it may be well to disinfect it thoroughly.

16. Pedigree-hatching (Figs. 231 to 235.)

In order to know the parentage of each chick, it is necessary to pedigree-hatch the eggs. It is necessary for progeny test-

FIG. 231. Steps in trapnesting. *Above left:* Before removing the hen be sure she has laid. Remove the egg before the hen and thus take no chance of leaving the egg in the nest. *Above right:* Catch the bird by the shoulder as she leaves the nest. *Below left:* Move the hen to the right or left side, her head under the operator's arm. In this position the number on the leg band may be easily read. *Below right:* The hen is then released carefully so that she will land on the floor litter without being injured.

ing. It is essential if one aims to make the most definite and rapid progress in breeding for egg production.

Some of the essentials for pedigree-hatching are:

(1) That each breeding female and male be banded so that the numbers can be easily read.

FIG. 232. *Left:* The hen number and also, when desired, the pen number are written on the large end of the egg when eggs are saved for hatching. *Right:* The hen number is then recorded on the pen sheet. Recording the hen number rather than a straight or cross mark is safer as it lessens the danger of marking in the wrong space, thus giving credit to the wrong hen. It also takes less time since the eye does not have to travel back across the sheet to locate the number of the hen.

(2) That a group of females be mated with a single male throughout the breeding season.

(3) That the birds be trapnested during the breeding season.

(4) That a breeder's record book be used to record the number of each bird, her annual production, and hatching record.

(5) That each egg be marked on the large end with the pen number and the number of the hen, at the time the hen is removed from the trapnest. *Example:* $\frac{1128 \text{ (Hen number)}}{15 \text{ (Pen number)}}$

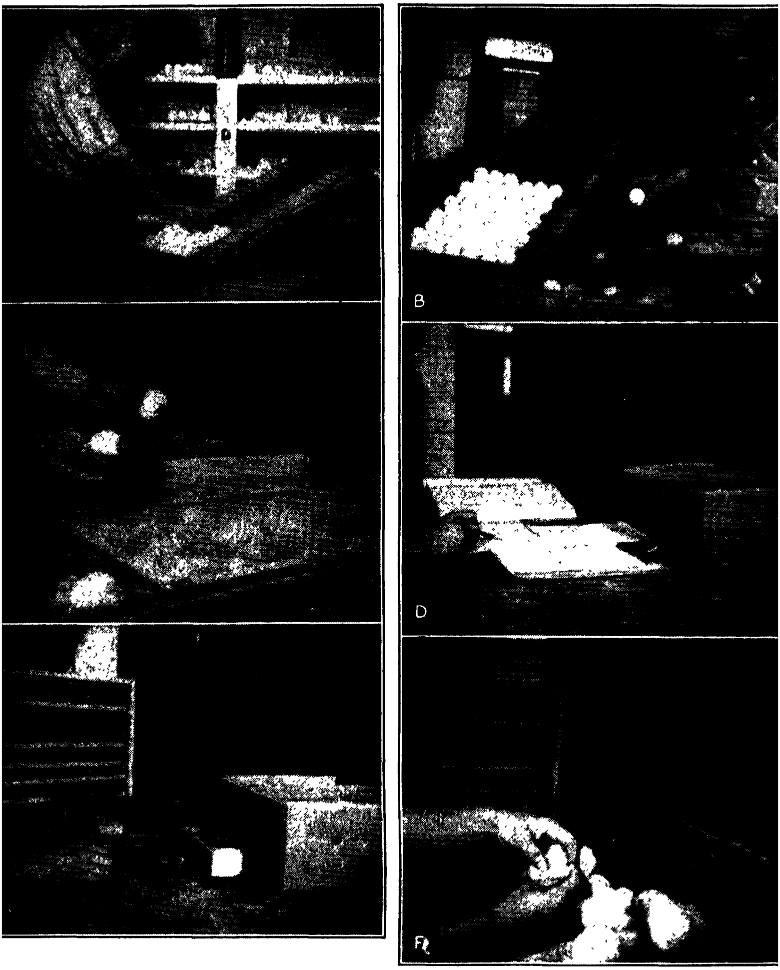

FIG. 233. Steps in pedigree hatching and wing banding.

A. The eggs from each hen are placed by themselves in the egg-holding room until transferred to the incubator tray. *B.* On the eighteenth day the eggs from the same hen are placed together in one or more compartments of the pedigree tray. A lid covers the entire tray. *C.* When hatching is concluded, the hen number of the chicks is determined by the number on any shell in the same compartment. *D.* Each breeding hen is credited with each chick hatched from her eggs. A number is given to the chick and recorded at the same time. *E.* The chick number is stamped on a wing band. (Bands may be purchased with part or all the figures stamped.) *F.* The chick is wing banded with the proper band.

(6) That before the eggs are placed in the incubator they be systematically arranged in the order of the hen numbers,

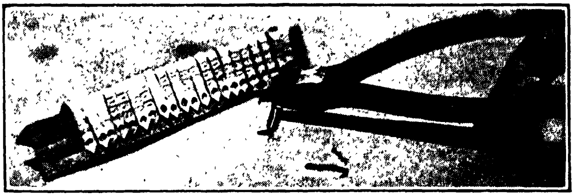

FIG. 234. Chick wing bands arranged in order and pliers used in fastening the band to the wing.

the eggs from each hen being grouped together in order that they may be placed in the machine and on the incubator record sheet for quick reference.

(7) That on the eighteenth day the eggs from each hen be placed in a separate basket, in order that the chicks from each hen may be correctly identified and banded.

(8) That each chick be wing-banded with a special clinched or sealed band so that, from the band number of each chick, its parentage can be quickly determined, by referring to the incubator record sheet and the breeder's record book (Numbers 4 and 6).

FIG. 235. Push the point of the band through the skin just behind the cord and just in front of the vein. The vein may easily be seen. Insert the band so that the number can be read easily when the bird is held in the usual manner.

(9) That a book of pocket size, properly ruled, be provided, and the wing-band number of each chick entered therein, in order, from the first to the last chick banded in each season, and that space be provided for entering, during the season, such information as will be helpful.

COMMUNITY SURVEY

1. Spend a period or more with a local poultryman and note the various operations performed in caring for the incubator.
2. What points are emphasized in the selection of hatching eggs? Why?
3. What attention is given to moisture within the machine?
4. Are hatching eggs cooled? Are they turned? When? How? Are they tested? When? How?
5. What temperature is used each week in still-air machines? In the forced-draft machines?
6. How long are chicks left in the machine after hatching?
7. How many poultrymen pedigree-hatch their chicks?
8. List the various steps used in pedigree-hatching.
9. Which give the best results in pedigree-hatching, bags or baskets?

REFERENCE

HARTMAN, R. C., and VICKERS, G. S., *Hatchery Management,* Orange Judd Publishing Co., New York, 1932.

CHAPTER XX

FORMATION OF THE EGG AND CHICK

A knowledge of the means by which nature surrounds the developing embryo with the conditions necessary for its life and growth and of the manner in which the embryo responds to these conditions is essential in arriving at an understanding of the principles of incubation. It will add interest to the daily task of running the incubator to realize that the egg, although perhaps incubated miles away from the sire and dam that gave it life, contains within the shell in microscopic form the germ of life capable of producing a perfect chick, when given the proper conditions for incubation.

General information:

1. Formation of the egg.
2. Structure of the egg.
3. Formation of the chick.

1. Formation of the egg

There are two parts of the hen's body that are chiefly concerned in the development of the egg, namely, the ovary and the oviduct (Figs. 236, 237).

A. Growth of the yolk. The yolk of the egg is the first part to develop; its development takes place in the ovary, which is located close to the backbone of the fowl. The ovary contains many hundreds of minute yolks (Fig. 237). If a normal fowl is killed while in laying condition, these yolks are found in all stages of development. Each yolk is enclosed in a sac, or follicle, through which it obtains its nourishment while developing.

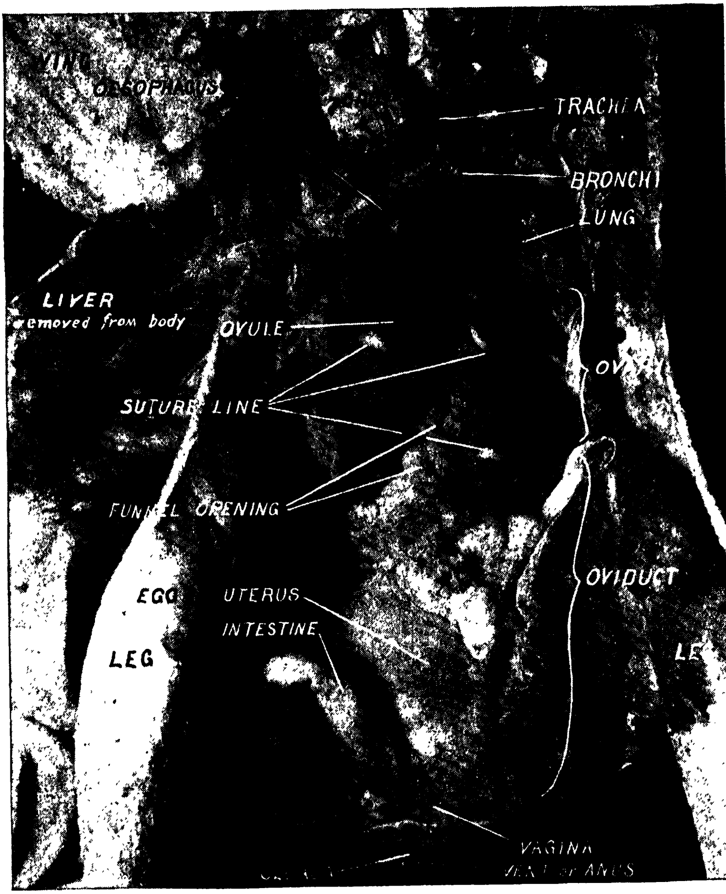

Fig. 236. The ovary and oviduct of a hen in heavy production. Note the distinct suture lines with no blood vessels crossing, and the many folds of the oviduct packed away in a comparatively small space.

The yolk is gradually built up in the "cell body of the egg cell" by the addition of concentric layers of yellow yolk around an inner case of white yolk. The nutriment for these growing ova, or yolks, is supplied by the hen from the products of her digested food, brought by the bloodvessels to the cells in the follicles and transferred by them to the growing ova.

According to Lillie,[1] the yellow yolk is laid on daily in regular layers, separated by very thin strata of the white yolk.

"The principal accumulation of white yolk lies in a central flask-shaped area, the latebra, which extends toward the germinal disc from the center of the yolk. This tube of white yolk flares out under the germinal disc into a mass known as the nucleus of Pander."[2]

As the yellow yolk is laid on, the germinal disc moves gradually onward, always remaining close to the vitelline membrane, and leaving behind it the tube of white yolk, across which no yellow yolk is deposited (Fig. 139, "Cross-section of an egg").

At Cornell University, A. L. Romanoff[3] found that about 7 days are required for the full development of the yolk from its original minute size. The layers vary in thickness probably owing to the physical condition of the bird, rate of laying, and the like. When the yolk is mature, the germinal disc appears as a light-colored spot on the surface. This may be seen when an egg is carefully broken into a saucer.

B. Yolk released at maturity. When the yolk becomes mature, the yolk sac splits along the suture line and allows the yolk, enclosed in its vitelline membranes, to drop into the body cavity. There the funnel-shaped opening of the oviduct envelops the yolk, and its passage through the oviduct begins. (Figs. 236 and 237.)

As soon as the yolk escapes from its yolk sac, the sac con-

[1] F. R. Lillie, *Development of the Chick.*

[2] B. M. Patten, *Embryology of the Chick.*

[3] A. L. Romanoff, "Growth . . . of . . . Fowl's Ovary," *The Biochemical Journal*, Vol. XXV, No. 4, 1931.

tracts and usually remains as unabsorbed tissue, although so much decreased in size that it is difficult to distinguish the yolk sac after a few weeks.

C. The albumen. As the yolk continues its passage, the various glands lining the oviduct secret the albumen. About 40 per cent of the albumen, or white, of the egg is supposed to be laid on as the yolk passes down through the upper half of the oviduct (Fig. 237).

The time occupied in passing through this region is about 3 hours.[1]

The first albumen to be deposited on the yolk is the very thin layer of dense albumen, close to the vitelline membrane and continuous with the chalazae. Next to the dense inner layer there is a layer of inner thin, surrounded by a thicker middle layer. Fig. 139, page 289.

D. The isthmus. After the yolk has reached the half-way point in its progress down the oviduct, it enters the isthmus (Fig. 237), where the shell membranes and 10 to 20 per cent more albumen are added. By this time the egg is beginning to assume its final size and shape. About 3 hours are required for the passage through the isthmus.[1]

E. The uterus. The uterus is the next portion of the oviduct into which the developing egg passes. Here the remainder of the albumen is drawn in through the shell membranes. The shell is also deposited in this section. The egg is ordinarily laid from 12 to 24 hours after it enters the uterus.[1]

F. The vagina. The egg then passes through the vagina, where some of the shell pigment and the outer gelatinous coating of the shell are probably added.

G. The cloaca. The completed egg is now ready for expulsion through the cloaca.

2. Structure of the egg

In the cross-section of an egg shown in Fig. 139, the various parts may be seen. Many of these parts may also be seen in a

[1] F. R. Lillie, *Development of the Chick.*

FIG. 237. The ovary and oviduct removed. Note the empty yolk sac split along the suture line, and the funnel opening of the oviduct into which the yolks drop.

hard-boiled egg that has been cut through longitudinally. The layers of light-yellow yolk and the tube of white yolk may often be observed.

The chalazae and the four layers of albumen can best be seen by opening a fresh egg into a saucer. The chalazae are attached to the dense albumen layer surrounding the yolk and on opposite sides of it. They extend out into the albumen toward the ends of the egg, or may be twisted up close to the vitelline membrane. A chalaza consists of a white, fibrous thread of albumen. The size of the chalazae varies in different eggs.

The chalazae prevent any rapid change in the position of the yolk, and cause the yolk to revolve on the long axis of the egg, thus keeping the germinal disc on the upper side, nearest the heat, during incubation.

The dense layer of albumen surrounds the yolk and is transparent. It may be seen by looking across the yolk on a tangent. The other three layers of albumen are easily seen in a fresh egg, the second layer being more dense and standing up more firmly than the outer layer. Cutting the second layer releases the inner thin.

The inner and outer shell membranes consist of a network of organic fibers, the inner one being of finer texture.

The shell consists of three layers.[1]

When the egg is laid, the shell is completely filled; but after cooling the contents contract and an air space is formed, usually at the large end of the egg and between the two shell membranes.

3. Formation of the chick [2]

The several stages in the formation of the chick are briefly described in the following paragraphs.

[1] F. R. Lillie, *Development of the Chick.*

[2] This description was gleaned from the junior author's notes, taken from lectures by Dr. Kingsbury of the Medical College, Cornell University. Patten's *Embryology of the Chick* was also freely consulted.

A. Fertilization. Through copulation with the male, countless numbers of spermatozoa are emptied into the oviduct of the hen. These spermatozoa make their way along the oviduct to the upper end. They will remain alive and fertilize eggs for two or three weeks after copulation.

Fertilization takes place in the upper end of the oviduct, just after the yolk passes into the funnel-shaped end of the oviduct and before any albumen is laid on (Fig. 237). In order that fertilization may occur, the nucleus of the female cell must fuse with the nucleus of the male cell. The female nucleus is located in the germinal disc, and the male nucleus is in the head of the spermatozoön.

From six to twenty-four sperm cells penetrate the germinal disc, but only one enters the egg cell and fertilizes the egg.

Nature has many devices for preventing the entrance of more than one sperm cell. Before fertilization, the sperms are attracted, but after one has entered and fertilized the nucleus the other sperms are repelled. The exact means employed for repelling the sperm cells is unknown.

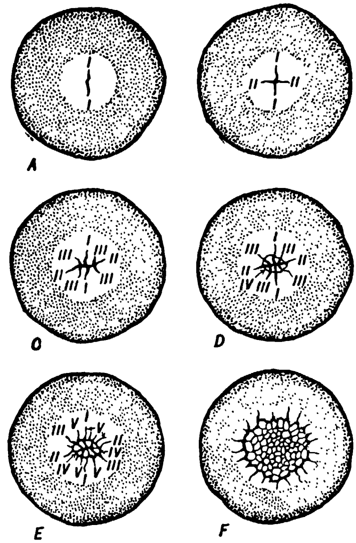

FIG. 238. Cleavage. Surface aspect of blastoderm at various stages of cleavage. Based on Blount's photomicrographs of the pigeon's egg. The blastoderm and the immediately surrounding yolk are viewed directly from the animal pole, the shell and albumen having been removed. The order in which the cleavage furrows have appeared is indicated on the diagrams by Roman numerals. *A*, First cleavage; *B*, second cleavage; *C*, third cleavage; *D*, fourth cleavage; *E*, fifth cleavage; *F*, early morula. From Patten's Embryology of the Chick.

As soon as the fertilization of the two nuclei is accom-

plished, the development of the embryo begins; and as the yolk passes down the oviduct, gathering albumen, on its way to the cloaca, the division of cells proceeds.

B. Cleavage (Fig. 238). The first division of cells occurs immediately after fertilization. This division is called cleavage.

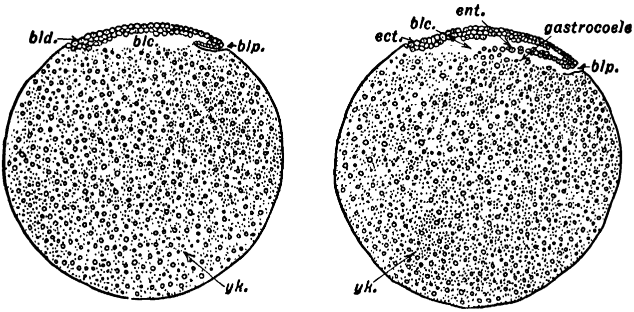

Fig. 239. Gastrulation in form with telolecithal egg containing large amount of yolk—birds. Schematic diagrams to show the effect of yolk on gastrulation. Abbreviations: *blc.*, blastocoele; *bld.*, blastoderm; *blp.*, blastopore; *ect.*, ectoderm; *ent.*, entoderm. From Patten's *Embryology of the Chick.*

The cells form on the germinal disc. The two fused cells divide and form two cells, each with part of the nuclear material. Each of these cells again divides at right angles to the first division, making four cells. After this each cell continues to divide and the number of cells is increased very rapidly. This group of cells in the germinal disc is called the blastoderm. The cells of the blastoderm are smaller in the center of the group and somewhat larger at the outside.

C. The blastula stage. The blastoderm, by the rapid formation of the new cells, is raised slightly in the center, forming a cavity between the yolk and the blastoderm (Fig. 239). This cavity is the blastocoele, or segmentation cavity.

The blastoderm touches the yolk on all sides except one, and here it is raised slightly. That section of the blastoderm

which remains on the yolk is termed the area opaca. The central part, which is raised from the yolk, is called the area pellucida.

The layer of cells as it exists at this stage is called the blastula.

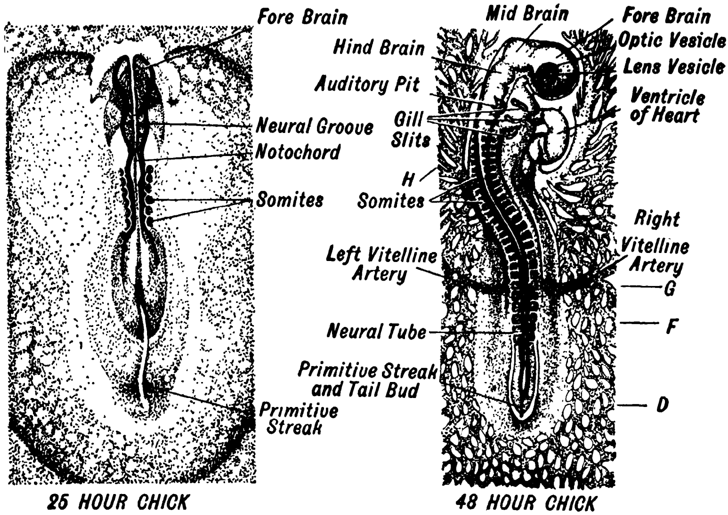

FIG. 240. Note the rapidity of growth and large size at the head end. Drawing from Duval's Atlas.

D. The gastrulation stage. Immediately after the blastula stage, the free edge of the blastoderm turns under and starts to grow inward (Fig. 239).

The blastoderm might be likened to a pancake lying flat on the surface of a large ball. Later the pancake is raised slightly in the center but remains attached at the edge, except along one side. The cavity thus formed is called the blastocoele; the section that remains attached to the yolk is the area opaca, and the raised section of the mass, the area pellucida (Fig. 249).

Still later, the free edge of the mass turns under, forming the beginning of the gastrulation stage.

The space between the yolk and the edge of the folded blastoderm is called the blastopore (Fig. 239). This folding under gives rise to two so-called germ layers, the upper surface of the blastoderm being the ectoderm, and the lower layer, or the one growing in under, the endoderm (Fig. 239).

The blastopore section is the rear of the embryo as it continues to develop.

The cells of the blastoderm continue to develop, spreading out over the yolk, except the part that is turned under. The

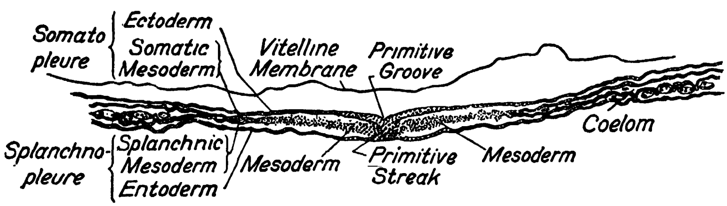

FIG. 241. Cross section through primitive streak. Thirty-six-hour chick.

sides continue to grow out and around until they come together behind the opening, or blastopore, in the meantime gradually pinching the lips of the blastopore together.

The stages described above are passed through before the egg is laid, and while it is passing down the oviduct to the cloaca. Up to this point, development is very slow. The embryo is so minute that all that can be seen with the naked eye is a slightly enlarged germinal disc, and possibly what may appear to be one or two rings of somewhat darker or lighter material on the disc.

First day of incubation. By the time the egg is laid, the lips of the blastopore have been compressed; and but a few hours of incubation are necessary before a streak known as the primitive streak is formed out of these compressed lips.

The growth of the embryo takes place at the front of the primitive streak (Fig. 240), the various parts growing out of it or coming from the space it has occupied. The primitive streak remains at the rear of the embryo throughout the de-

velopment and finally becomes the tail bud (Fig. 240, right).

The growth developing out of the primitive streak may be compared to a stick which is drawn through the water. The ripples and waves grow out from the place where the stick has been. In a similar way, the embryo develops just ahead of the primitive streak.

The mesoderm. We have spoken of two germ layers, ectoderm and endoderm. A third germ layer (mesoderm) soon

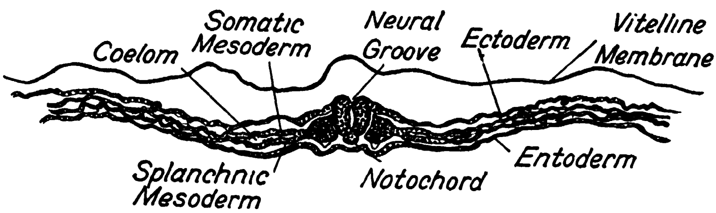

FIG. 242. Cross section ahead of primitive streak. Thirty-six-hour chick.

develops. From the sides of the fused lips of the blastopore and in the space between the ectoderm and the endoderm, formed by turning under during the gastrulation stage, a growth takes place, extending out between the two germ layers. This is the mesoderm (Fig. 241).

This completes the three germ layers characteristic of all vertebrate embryos. All the organs develop from these three layers.

Function of ectoderm. The ectoderm forms the outer covering of the body, the feathers, nails, skin, etc., together with the nervous system and the sense organs.

Function of endoderm. From the endoderm is developed the lining of the digestive tube, of the respiratory organs, and of the glands associated with them.

Function of the mesoderm. The muscles, the lining of the body cavity, the organs of the circulatory system, the blood, the lymphatic organs, and the urinary system are formed from mesoderm.

The notochord. As the primitive streak moves backward, an elongated, circular growth of mesoderm, known as the notochord, is left (Figs. 240 and 242). Around this is later formed the bony axis or vertebral column of the body. The notochord itself largely disappears.

The neural groove. A thickening of the ectoderm above the notochord occurs also. It is caused by rapid growth of the cells there, and forms the neural plate. The center of this plate becomes depressed, forming a groove (Figs. 240, 241).

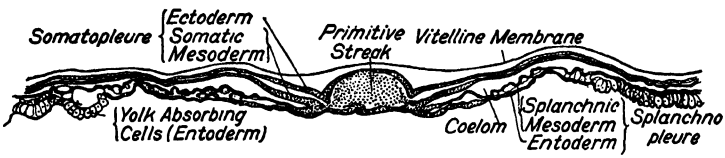

FIG. 243. Cross section through primitive streak. Forty-eight-hour chick.

This formation is the first indication of the central nervous system. Later, the groove deepens and the outer edges of it come together, fuse, and separate from the neural groove, thus leaving it below the surface and above the notochord (Fig. 242).

The head. At 21 to 22 hours of incubation, the front end of the embryo shows a thickened area, raised above the blastoderm. This is the beginning of the head.

The area vasculosa. At 24 hours, the area opaca appears somewhat more dense near the area pellucida. This is due to the growth of mesoderm, which has reached the point where the blastoderm meets the yolk. The mesoderm collects in clusters, forming blood islands. This is the first step in the formation of bloodvessels and corpuscles. The darkened area is the area vasculosa (Fig. 250).

The somites. On either side of the neural groove, outgrowths of mesoderm appear, developing in pairs. These are called somites (Fig. 240). In all, there are forty-two somites

that persist. The first three or four go into the head. Some of those at the extreme rear end of the series of somites degenerate. Nerves develop later for every somite, whether it has degenerated or not.

As the chick develops from the head end toward the rear, some of the older somites are converted into vertebrae before the last somites are formed.

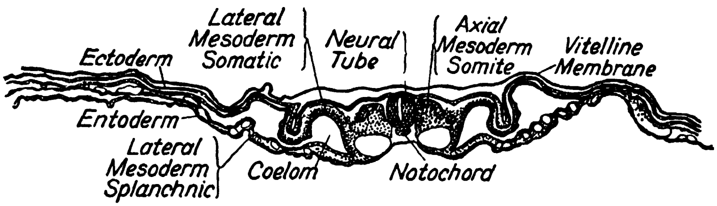

FIG. 244. Cross section ahead of primitive streak. Forty-eight-hour chick.

In 95 to 98 per cent of all cases, the embryo lies with the head at right angles to the long axis of the egg; i.e., the tail is toward you if the large end of the egg is at your left and the small end at your right (Fig. 250).

Second day of incubation. An interesting feature, illustrating the rapidity of the development of the chick, is the growth of the heart (Figs. 240, 250). On the second day, growth is so far advanced that on opening an egg into a saucer the heart may be seen to beat. Beating usually starts at 44 hours.

The embryo continues to elongate, and the neural groove becomes closed over (Fig. 244).

The walls of the head project, and the formation of the eye is started.

The three parts of the brain begin to develop (Fig. 240). (See page 143 for the relation of the brain to killing.)

The auditory pits, or sensory parts of the ear, may be seen developing from the ectoderm of the head.

The formation of the urinary system is begun on this day.

During the second day, the chick's body turns on its left side, and the head end is bent around toward the tail (Figs. 240 and 250). Later development shows the end of the beak and the tail close together.

The fetal membranes. During the early development of the chick embryo, certain fundamental life conditions are

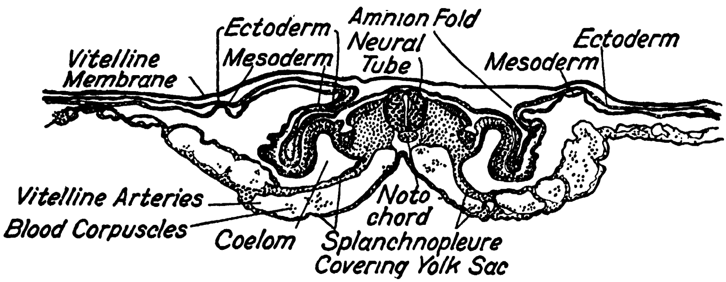

FIG. 245. Cross section through vitelline arteries. Forty-eight-hour chick.

necessary. In fact, one of these life conditions, namely, heat, must be present before development will start. These life essentials are:

(*a*) Protection.
(*b*) Heat.
(*c*) Food.
(*d*) Water.
(*e*) Oxygen.
(*f*) Care of waste products.

With the exception of heat, these essentials are all supplied by growths of the fetal membranes from the inside of the egg and from around the developing embryo. These growths are four in number.

The yolk sac. The yolk sac supplies food and water to the developing embryo. It starts to form when the three germ

layers commence to develop. As the germ layers progress outward and downward over the yolk, and the embryo grows, other parts develop, forcing the embryo up and the yolk down, until a thin stalk extends from the under side of the embryo to the yolk (Figs. 245, 247, 248). This is the yolk stalk and is the connection from yolk to embryo.

The inner layer, or endoderm, and the inner layer of the mesoderm grow down and around the yolk.

The yolk sac and contents are drawn into the body of the chick at about the nineteenth or twentieth day. The yolk, thus enclosed, acts as food for the chick during 3 or 4 days after hatching. In about 6 days after hatching, the yolk and sac are largely absorbed.

The amnion. The amnion gives protection to the developing embryo from the upper side. It starts to grow at about 30 hours and is fully developed at 3½ days.

It is formed from the outer layer of ectoderm and mesoderm (somatopleure) (Fig. 243). The somatopleure starts to bend up and over the embryo (Figs. 245, 247), finally joining and fusing, above the embryo and separated from it as shown in Fig. 248, left. The amnion is just over the embryo and consists of two germ layers, which are folded over and fused, leaving the mesoderm above and the ectoderm below.

The space between the amnion and the embryo is the amniotic cavity and is filled with a fluid which acts as a protection to the embryo as the egg is moved about.

The serosa. As soon as the amnion is formed, the fusing from either side of the embryo causes the release, or severing, of the layers there, and a new membrane (the serosa) is left around the entire embryo and amnion. In this membrane, the ectoderm is the outer, and the mesoderm the inner, layer (Figs. 246 and 248). Thus the folding of the somatopleure has formed two membranes, the amnion and the serosa.

The serosa, with the allantois, carries oxygen to the embryo and carries away the carbon dioxide.

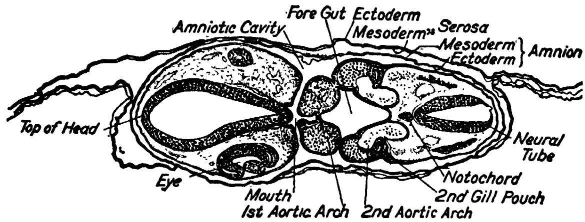

FIG. 246. Cross section through body and head after the head has turned down. Forty-eight-hour chick.

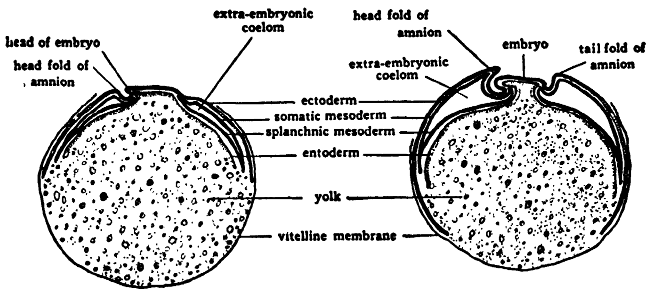

FIG. 247. Schematic diagrams to show the extra-embryonic membranes of the chick. The embryo is cut longitudinally. The albumen, shell membranes, and shell are not shown. *Left:* Embryo early in the second day of incubation. *Right:* Embryo early in the third day of incubation. From Patten's *Embryology of the Chick.*

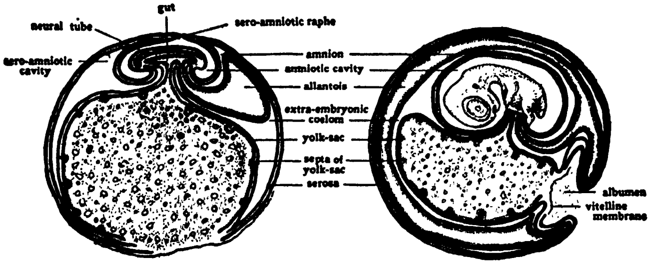

FIG. 248. *Left:* Embryo of five days. *Right:* Embryo of nine days. From Patten's *Embryology of the Chick.*

The three membranes remain in communication, in the region of the yolk sac, until late in the development of the embryo.

Third day of incubation. *The allantois.* Late the third day, the splanchnopleure (Fig. 245) close to the yolk sac

FIG. 249. The blastoderm at 18 hours of incubation. The shell and shell membrane have been removed just above the blastoderm.

and toward the rear of the embryo, forms a hollow bud which grows out rapidly and develops into the allantois (Figs. 248, 251, 252). As it grows, it becomes filled with a fluid, which distends it. This rapid growth continues until the tenth day and until the allantois takes up the space between the amnion and the serosa. The outer layer of the allantois is mesoderm. It fuses with the mesoderm of the serosa and becomes filled with bloodvessels. The serosa is pressed close to the porous shell, and in this way oxygen is taken in and carbon dioxide given off. The allantois also helps to absorb the albumen of the egg and stores up non-gaseous waste matter.

Thus, the four fetal membranes accomplish several of the fundamental life conditions, as follows:

(*a*) The yolk sac furnishes food and water.
(*b*) The amnion provides protection.
(*c* and *d*) The serosa and allantois supply oxygen and remove waste products.

FIG. 250. The embryo at 66 hours of incubation. Note the position of embryo with respect to the position of the egg. Also the well defined outer edge of Area Vasculosa.

These membranes function only during the incubation period and are discarded before the chick is hatched.

Wings and legs. The wing and leg buds appear during the third day and may be seen at the side and well toward the rear of the embryo (Figs. 251, 252).

During the third and fourth days, there is rapid growth of those internal organs which have already begun to develop. Others, such as the lungs, trachea, esophagus, liver, pancreas,

and cloaca, together with the rudimentary sexual organs, start their development at this time.

The development of the embryo during the fifth day and thereafter consists in the further growth of buds or organs already started. By opening two or three eggs each day one can readily observe this growth.

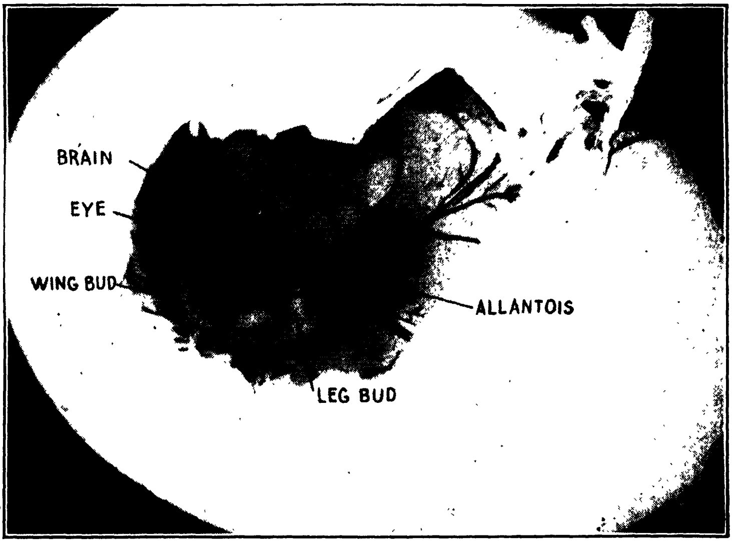

Fig. 251. The embryo at 114 hours of incubation. Note the wing and tail buds and the allantois.

Sixth to tenth day. By this time the mouth opening has taken on the form of the beak, and the slightly roughened surfaces of the body show where the feather tracts will be formed.

On the sixth day, the movements of the chick may be seen, through the shell.

Daily observations show the growth of wings, legs, toes, nails, feathers, head, and tail. The internal organs, of course, keep pace, in their growth, with the external parts.

The fluids in the egg gradually evaporate. On the nineteenth day, the air cell is very large, approximately one-fifth to one-quarter of the egg, and the chick fills the remainder of the shell.

Just prior to hatching, the yolk is drawn into the body, and the body wall closes over it. The fetal membranes are cast off. The chick breaks the shell, at the large end, with its beak, turning in the shell as it breaks. Finally, by pushing and pounding as it gains strength, it forces the top off and thrusts out its head and neck.

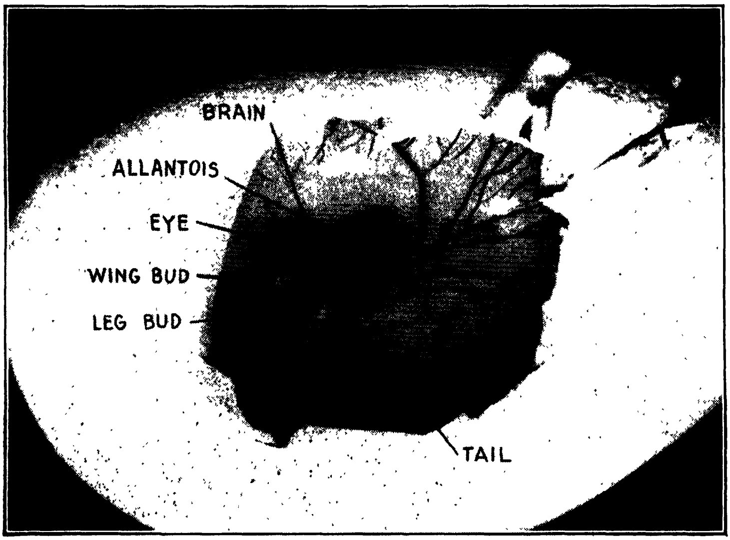

FIG. 252. The embryo at 5½ days of incubation.

When the chick breaks through the shell and secures access to fresh air, the lungs take over the function of blood purification, which until then has been carried on by the serosa and allantois. The period of transition from the embryonic to this final stage is a critical period in the life of the chick. The rapid breathing of the chick during its effort to break through

the shell calls for a larger amount of pure air than has been required in the earlier stages. This fact must be taken into consideration in the construction of incubators and their operation at hatching time. In nature, this requirement of the chick is taken care of by the circulation of pure air through

FIG. 253. Embryo about 7 days. The weight of the embryo has caused it to sink into the yolk, making it impossible to see it distinctly. Note the size of the eye.

the feathers of the hen and by the instinct which leads the newly hatched chick to seek the pure outer air.

Usually, the chick rests for a while and pants from its efforts, until with a final kick and plunge it is free. As the heat dries the down on its body, it gains strength and in a short time is walking about, a live, downy, alert chick, following its natural instincts of picking for food.

It has started on its comparatively short, eventful life. Its future achievements are largely in the hands of the poultryman.

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CHAPTER XXI

BROODING THE CHICKS

Brooding is one of the poultryman's most difficult problems. It is a part of the business that must not be slighted. If the chicks are not properly brooded they may never make as successful layers as properly brooded chicks of the same breeding.

The necessity of renewing 50 to 100 per cent of the flock each year, owing to the short normal life of the domestic fowl, is one of the most important causes of failure in poultry keeping. None of the other domestic animals require this. Each chick that dies represents an economic loss which cannot be fully overcome in the same hatching season.

The ability to rear well developed pullets at a reasonable cost may mean the difference between profit and loss on the poultry enterprise.

Operations:

1. Choosing the brooder.
2. Preparing the brooder house and heater.
3. Operating the heater.
4. Putting the heater to the test.
5. Providing protection.
6. Moving the chicks to the brooder.
7. Managing the chicks.
8. Letting the chicks out of doors.
9. Training the chicks.
10. Brooding with the hen.

General information:

Principles of brooding.
Brooder house construction.

1. Choosing the brooder

The quality of the stock reared should be the main consideration in any brooding system. The size of the flock and the brooder house influence the type of brooder used. If but 50 or 100 chicks are to be brooded, one of the small indoor or outdoor lamp brooders may suffice.

FIG. 254. A permanent brooder 25′ × 25′, at the right, which does the brooding for a 1200-hen plant. After the pullets are moved to the range, the brooder, lean-to, and old building attached are used as a barracks (page 510).

The lamp brooders are usually heated with oil lamps. Fresh air is warmed by coming into contact with a heated surface and is released in the hover chamber. The chicks are thus given fresh, warm air to breathe.

All the small lamp-heated brooders holding 50 to 150 chicks require considerable attention in proportion to the number of chicks brooded, and none of them are to be recommended where 200 or more chicks are to be brooded.

A. Permanent brooder house. This system of brooding provides conditions somewhat easier for the operator early in the season when the weather is cold or for brooding to 8 or 10 weeks of age. It is more economical of fuel. This brooder was unsuccessfully used years ago, before vitamins were known and when the control of chick diseases was in its infancy.

Modern methods are likely to result in a return to permanent houses, rearing in shelters when the pullets can be removed from the heat (Fig. 289), and using the house as a hen barracks (page 510) or for growing broilers for market. Hot water pipes or individual stoves can be used. Large pens, 25 feet square with one brooder stove, will accommodate 500 to 600 chicks until 8 weeks of age, when they should be moved to the range in shelters. The size of the house will be governed by the job to be done.

B. The colony brooder replaced the permanent house because exposure to direct sunlight and change of range gave better results. Labor cost for brooding is high, size of flock is necessarily small, and warm weather brooding is difficult.

The colony house is still used in great numbers although with less enthusiasm than formerly. Coal, oil, gas, or electric brooders furnish the heat (Figs. 255, 257). From 250 to 300 chicks under one hover provide excellent conditions.

The colony brooder is portable and may be used on range as a range shelter.

C. Oil heaters. Oil heaters are being used in larger numbers but not as extensively as coal heaters. During very warm weather they are easier to operate than coal stoves (Fig. 258).

Many modern oil heaters give excellent results. Desirable features are provision to prevent surplus oil from spreading and causing fire, thermostat control of the oil feed, and a convenient method of cleaning carbon from the heater.

D. Confinement brooding and rearing. (1) *The floor method.* Chicks may be brooded inside until 8 to 12 weeks old with or without an outside wire run (Fig. 266), or in permanent brooders or in laying houses which they will eventually occupy as layers. Overcrowding must be avoided. Allow approximately 1 square foot of floor per chick. Ample space for feed and water is essential. Escape from the intense heat of the brooder stove and of the sun must be provided. Pullets reared to laying age in confinement with an allowance of at

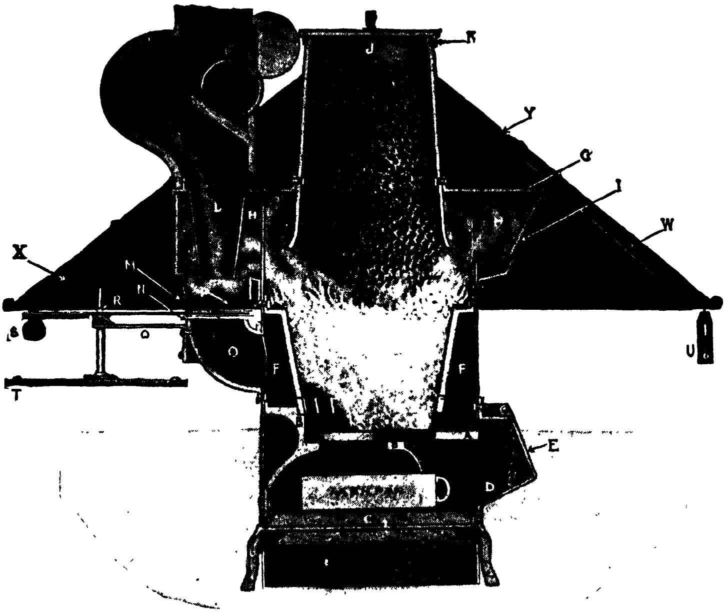


FIG. 255. Cross-section view of Newtown colony brooder. A, Grate; *B*, grate rest; *C*, air space between double bottoms; *D*, sloping surface to ash pit door; *E*, ash pit door; *F*, air space between fire-bowl and metal jacket; *G*, opening between combustion chamber and radiator; *H*, radiator; *I*, observation door; *J*, coal magazine; *K*, magazine cap and ground-joint-union between magazine cap and magazine; *L*, down-draft flue; *M*, check-draft opening; *N*, main-draft opening; *O*, lower-draft elbow; *P*, damper discs; *Q*, regulator support; *R*, adjusting nut; *S*, counterbalance weight; *T*, thermostat; *U*, thermometer; *V*, thermostat bracket; *W*, deflector lid; *X*, small door in deflector; *Y*, deflector; Z, smoke-box clean-out. The metal ring or band is placed under the stove to prevent chicks from crowding under it. From Newtown Incubator Co.

least 2½ square feet per pullet and with all the benefits of good rearing except for free pasture range, but with an ample supply of green feed, developed into desirable pullets.

Although range-reared pullets are preferred when proper range is available, many fine pullets are reared in confinement each year either because of necessity or choice.

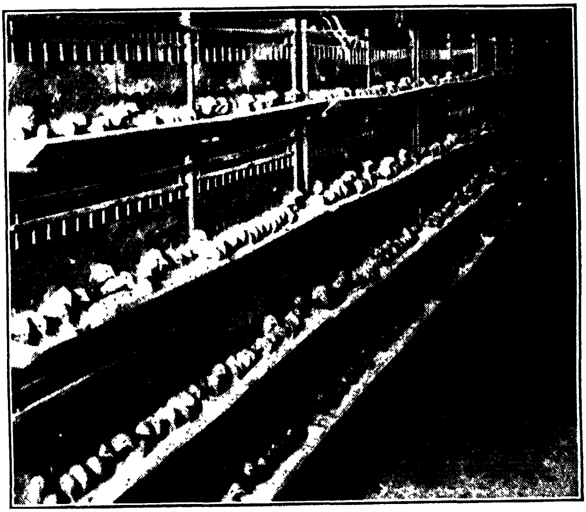


FIG. 256. A large battery brooder. The chicks are transferred to colony houses at an early age. Ample room, large, warm, and well ventilated quarters have helped chicks through this battery period for a number of years on this New York State farm.

(2) *Battery brooders.* The use of batteries for brooding chicks is an attempt to decrease labor by reducing travel in brooding. It undertakes to economize space by confining chickens in compartments several tiers high (Fig. 256). The more completely the battery provides the essential factors of natural brooding, the more successful it is. These essential principles are: (*a*) access at all times to a comfortable temperature without wide extremes and with opportunity for a choice of heat; (*b*) abundance of space for feeding and water-

ing in proportion to the floor area; (*c*) ease of cleaning and disinfecting; (*d*) portable parts; (*e*) economy of fuel; (*f*) convenience in handling chicks in and out of the brooder; (*g*) suitable control of heat, ventilation, humidity, and sunlight.

Even under the most favorable circumstances, conditions are distinctly artificial and require skillful handling in order to secure satisfactory results.

The field of usefulness of battery brooders is exceedingly limited. Their chief value is as a short-time nursery for holding chicks not more than 1 or 2 weeks at most, except for broiler purposes.

The sooner properly developed battery baby chicks destined for layers can be placed on the floor near the hover of a colony house brooder, the better it will be for the chicks. Within a day or two they should be allowed the freedom of the house; and within a week or so to go outside on a wire-floored sun-porch, or better yet, upon a clean grass sod.

The chief objection to battery brooding is the indoor sedentary life of the chicks, owing to lack of exercise because of close confinement. For the production of broilers of the lighter weights, the best types of battery brooders serve a useful purpose, provided they are properly managed. The best-quality broiler is sunshine grown, with freedom of action —factors that are not provided in battery brooding.

A failure on the part of many types of battery brooders to provide proper choice of temperature, humidity, and sunshine accounts for much of the difficulty of rearing chicks to maturity in close confinement.

Battery Capacity [1]

There is a tendency to over-rate the capacity of batteries beyond the first week or two. Crowding should be avoided since it results in

[1] From a mimeograph by L. M. Hurd and J. H. Bruckner, Cornell University, Ithaca, N. Y.

retarded growth and poor feathering and leads to feather picking and cannibalism.

A 3×3 foot battery compartment will provide ample room for 100 chicks for 10 days or 2 weeks. After that double the floor space about

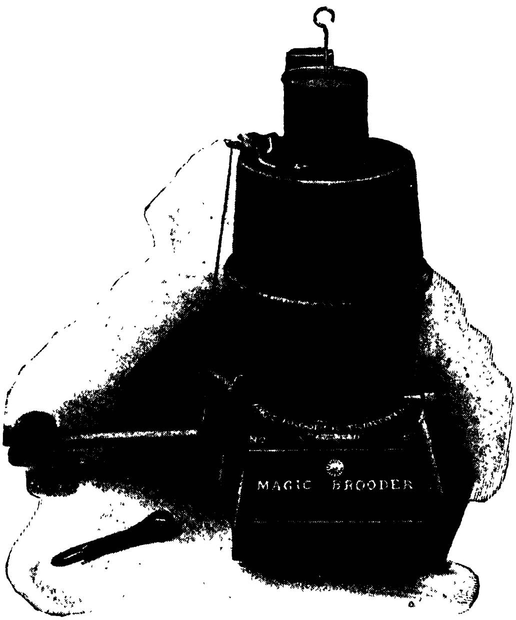


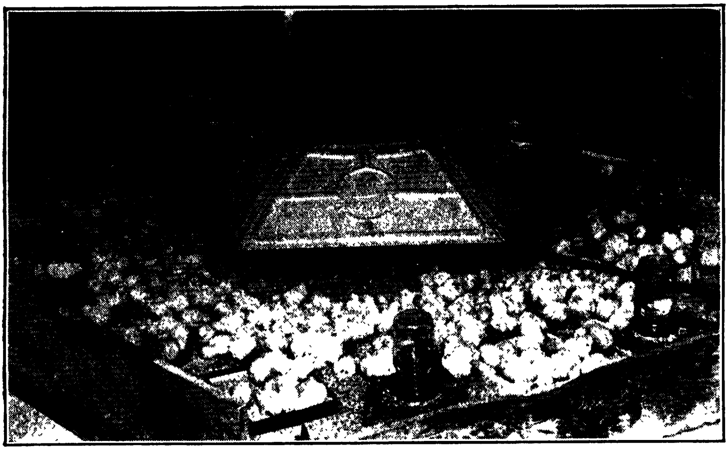
FIG. 257. A coal-stove brooder. Note the wafer thermostat operating both check draft and direct draft. From United Brooder Co.

every 2 or 3 weeks. The following table gives the average capacity recommendations at different ages.

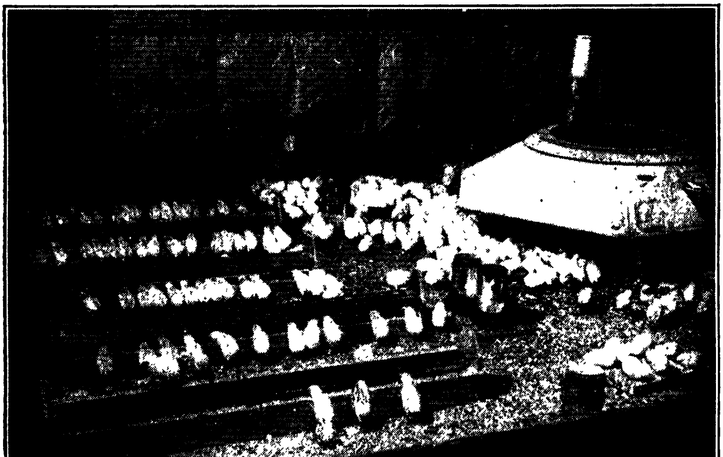
Number of chicks for a 3×3 foot battery compartment:

1st to 3rd week	not over 75 to 100 chicks
3rd to 6th week	not over 35 to 50 chicks
6th to 12th week	not over 18 to 25 chicks
12 weeks and afterward	not over 15 chicks

Some operators allow a little more space for heavy breeds like Plymouth Rocks and R. I. Reds than for lightweight breeds like the Leghorn.



A.



B.

Fig. 258. The brooder is the seat of warmth and protection for several weeks. *A*. The first day in the brooder. Note the several quart waterers and box-lid feeders well distributed. *B*. The same chicks on the third day. Note the enlarged pen, long feeders with sides 2″ high, and the gradual concentration of small waterers. Bodies are growing rapidly, keeping pace with the large wing feathers, indicating healthy active development.

E. Electric brooders are being more generally used. They appear less desirable for early brooding, as auxiliary heat is sometimes required for maintaining a room temperature of 45 to 50 degrees F. in the fall, winter, and early spring. They are much better adapted for later season work and they are considered superior during warm weather because the temperature beneath the hover may be completely controlled.

An essential is low cost per kilowatt-hour. Coal appears to be cheaper for early-season brooding and electricity for warm weather, providing the current costs not over 2 to 3 cents per kilowatt-hour. The saving of labor and lessened danger from fire are advantages.

More desirable conditions of humidity and ventilation are secured by placing the brooder on a platform of 1-inch boards supported on cleats 1 inch high. A central ventilation tube in the brooder is helpful.

Electric brooders differ greatly in their efficiency. They are destined to increase in popularity as they become improved and the cost of electric current is reduced.

F. Underfloor or radiant heat. The most recent method of brooder construction consists of laying heating pipes in the concrete floor. The warmth passes into the room and all parts of the floor are of the same temperature. Hovers are not needed; the chicks are warm wherever they are. The reasons for crowding are reduced. Used in permanent brooders, this type of heating may offer possibilities, and the results will need to be watched and studied.

Installation expense is considerable; extra equipment may be necessary to help adjust the room temperatures to sudden changes; provision may be needed to provide the chicks with a range of temperature; and excessive dehydration must be guarded against.

As this edition goes to press, installations of underfloor heat are numerous.

Radiators with fan and hot water pipes behind ceiling panels

are being considered as possible means of supplying brooder heat.

2. Preparing the brooder house and heater

If the colony house is used, raise the house about a foot above the ground. Boards should be placed on all sides to prevent the chicks from running under the house during the

Fig. 259. Six-weeks-old Leghorn pullets in large brooder room. Note 5-gallon waterers on wire-top frame. The change from quart to 5-gallon water containers was made during the second week. Chicks are using perches and are uncrowded, with about 1 sq. ft. of floor space per chick.

first 2 or 3 weeks. After that, the boards may be removed. The chicks should then be old enough to find their way back into the brooder, and the raised building provides a place beneath which the chicks may run for shade and shelter.

See that the floor is tight. If there are cracks between the boards it will be advisable to cover them with a non-burning roofing paper and lay boards on the paper to hold it in place and provide extra warmth, especially beneath the hover.

Regardless of the kind of brooder house used, be sure it is

thoroughly cleaned and disinfected before the chicks are placed in it. Scrape all sediment from floor and walls and sweep clean. Next scrub the floor, using a stiff broom and scalding hot water into which lye has been placed at the rate of 1 ounce ($1/13$ can) to 12 quarts of water. After the house is dry, disinfect well (page 273). Examine the roosting quarters and along cracks, to see if there are grayish specks denoting

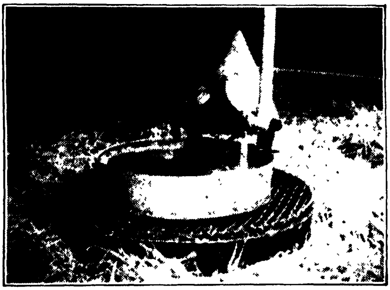


FIG. 260. A brooder watering device. An automatic waterer with float and wire-top stand keeps a fresh supply in the receptacle and the litter dry.

the presence of red mites. If mites are found, take the precaution to eliminate them. (See page 254.)

Next, overhaul the heating apparatus, making certain that all parts are present and workable. Do this several days in advance; never leave it until the chicks are ready for the brooder. Broken parts may cause several days' delay.

Set up the brooder, taking care that all parts are properly adjusted, that the pipe extends through the roof to a total distance of 10 feet or more from the brooder and that the roof cannot leak. Cover the floor near the heater with ½ or ¾ inch of litter which is free from all mustiness. Shavings, clover, alfalfa, or clean straw, cut into 1-inch lengths, may be used, scattered over the entire floor.

Hayseed or chaff is not desirable.

Ten-inch guards of boards, roofing paper, or special paper

should be placed around the hover within 18 inches to 2 feet of it.

Place a board or strip of roofing paper or a bank of straw in each corner of the house to make it round. If it is left square, the chicks may crowd into the corners and smother.

For the first 4 or 5 days provide 2 shallow trays to each 50 chicks for feed and a 1-quart jar water fountain to each 50 chicks. One or more "reel" feeders with 2-inch sides may be used in addition to the trays. After 4 days, use one 4-foot feeder for each 100 chicks (Figs. 259, 263, 264).

A 10- or 25-watt light in the room is an advantage. Use each night that chicks are in the brooder.

3. Operating the heater

For both oil and coal heaters regular attention is necessary night and morning. Check the oil supply and flame condition in the oil heater at least twice daily and the carbon accumulation each day. The electric brooder may need the least attention. Shake the coal stove at night and in the morning until live coals are seen at the grate. Then fill to the top with coal. Either pea or chestnut coal may be used, the latter being preferred. Remove ashes twice daily in cold weather. In certain models, the hover is arranged to be lifted. It is not necessary or desirable to raise the hover during the first 2 or 3 weeks, unless the temperature under it should become too high. In this event it will be necessary to adjust the regulator, since lifting the hover and cooling the heater would turn on the draft and cause the fire to burn faster.

In very warm weather, it is desirable to raise the hover during the day in order to keep the fire from going out. This lets the heat escape and causes the regulator to allow sufficient draft to keep the fire burning.

When first starting the stove, watch the thermostat, and, by means of the thermometer, regulate it so that the dampers will operate at approximately the correct temperature. Avoid too high a temperature since this may destroy the thermostat,

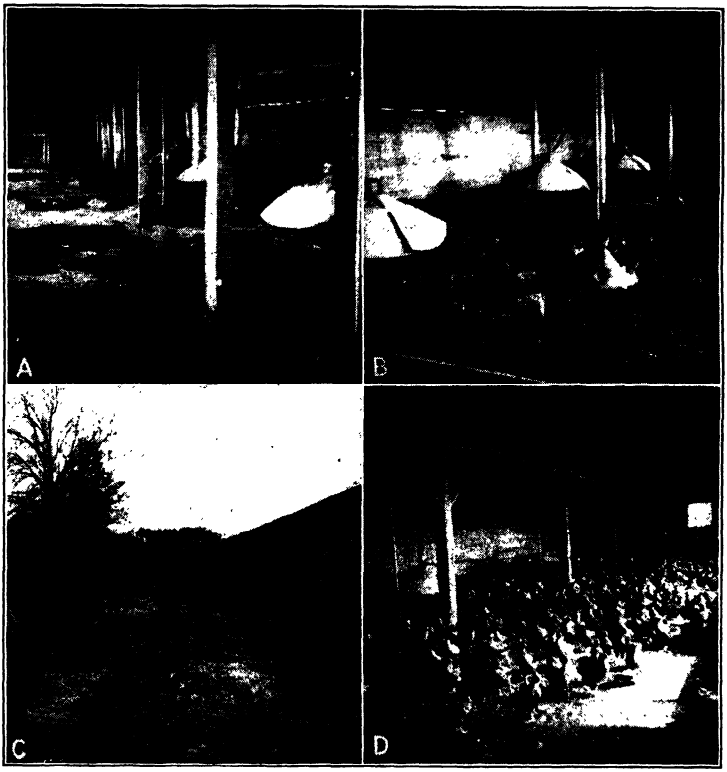


FIG. 261. Four stages in brooding and rearing broilers in the Del-Mar-Va peninsula region. *A*. The first job is to thoroughly clean and disinfect buildings and equipment. *B*. Week-old chicks in their brooding quarters. Pens 12′ × 20′ hold 250 to 300 chicks each. *C*. At 2 weeks, out on range adjacent to the building. Often all the chicks from a long house are allowed out together in a large yard or onto free range, previously seeded to corn, oats, or rape. *D*. Approaching the age of 13 to 15 weeks when they are marketed as large broilers or fryers.

especially if it is of the wafer type. Once it is operating correctly, it may be regulated to suit the chicks by slightly turning the adjustment nut.

4. Putting the heater to the test

With everything ready, start the brooder and run it for 1 or 2 days before the chicks are put in the house. This precaution may avoid injury to valuable chicks.

FIG. 262. Colony houses placed 100′ apart on grass, with a strip of oats 30′ wide to the right of the buildings. Shade and abundant range are available. The forage would have been improved by mowing occasionally to a height of 3″ to 4″.

The temperature at which to run the stove will vary with the season and the brooder. The chicks should be comfortable. If too warm or too cold, they will not develop properly. In general, the temperature at the outer edge of the hover and about 2 inches above the floor should be approximately 100 degrees F. As the chicks grow, this temperature may be decreased until artificial heat is entirely discarded.

The best thermometer is a healthy chick. The successful brooderman pays little attention to the registered temperature

but is guided by the actions of the chicks. When comfortable, the chicks, early in the evening, are spread out around the edge of the hover, some alone and others together in little groups. Their heads are often lying on the litter and their wings spread out. This attitude in sleep denotes "chick comfort." If the chicks are huddled together or are all under the hover, more heat is desirable. It is well to use a thermometer when first testing the brooder, in order to be somewhere near correct; after this it is not needed.

5. Providing protection

The life of young chickens is beset with many dangers. Time and money will be saved if the poultryman anticipates the chick hazards and takes proper precautions to prevent them. These hazards are many and difficult to overcome completely. An experienced poultryman will have no difficulty in recalling at least a score of preventable ways in which he has lost chickens.

Among the dangers to be overcome are losses from the depredations of dogs, cats, rats, weasels, skunks, foxes, crows, hawks, owls; losses due to chicks falling in holes, barrels, and pails, getting caught in wire, chilled in the rain, overheated in the sun, destroyed by fire, stepped on by farm animals, poisoned by drinking sour milk from galvanized dishes, by eating poison intended for their enemies, or by having access to old paint cans; smothering; and stealing by chicken thieves.

The brooding season, therefore, should be preceded by a clean-up campaign to destroy natural enemies and to prevent accidental losses.

6. Moving the chicks to the brooder

If the chicks are all hatched on the twenty-first day, they may be transferred the evening of the twenty-second day. Use long, shallow boxes, or baskets, and cover with a flannel cloth or burlap when moving the chicks. Do not smother

the chicks by piling boxes of chicks one on top of the other. They are delicate and must be handled with judgment.

Chicks received by express or mail will be taken directly to the brooder in their shipping boxes. Remove the chicks by hand and place carefully near the hover. They should start at once to eat and drink.

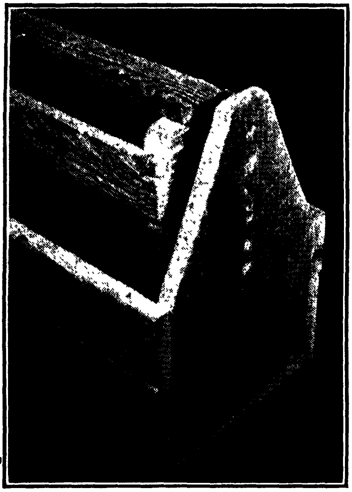


FIG. 263. Homemade chick feeder. It may be made 4″ or 5″ wide with removable side boards, each 2″ wide, and adjustable lath reel. Chicks will feed the first day from the feeder level full of mash and sides 2″ high. As they grow, less mash is put in to avoid wasting. At 1½ to 2 weeks, the other 2″ side is attached, and the reel is raised to permit head space between the edges of reel and feeder sides.

7. Managing the chicks

The first feed should be given the chicks upon arrival at the brooder. This feed should be a good grade commercial feed.

First 2 days. Keep the chicks within 2 to 3 feet of the brooder. Feed mash in the box lids (one or two handfuls several times daily) and in "reel" feeders filled to the top of the 2-inch sides. Keep the water dishes supplied. The temperature should be 90 to 95 degrees F. under the brooder itself. The room in which the brooder stands may be much colder.

Third and fourth days. Let the chicks go 5 to 6 feet away from the hover. Place a 4-foot feeder with "reel" for each 100 chicks. Leave box lids, removing one or two each day until all are out.

Place a wire top frame in the pen and set one permanent water fountain on it, and another on the floor near by. Remove one small water jar each day until all are gone.

Fifth day and later. Remove the guards and allow the chicks the entire pen or room.

Rake the litter on the floor to stir and loosen. Use a garden rake or other means. Repeat each day until the chicks are moved to the range.

Further directions:

Clean the water dishes every day.

Start feeding intermediate grain at 4 weeks in a separate feeder. Give small granite grit in separate feeder. Change to coarse cracked corn, wheat, and oats at 6 to 8 weeks.

Seventh and eighth weeks. Move the pullets to the range. Provide four range shelters or colony houses per acre, placed 100 feet apart, and put 100 to 125 pullets in each shelter.

FIG. 264. Chick feeder 4″ wide using a 2 × 2 for a reel resting on nails that fit into holes bored on a slant. The height of the reel above the mash can be adjusted by relocating the nails.

Change to whole corn, wheat, and oats between 9 and 11 weeks. Give granite or calcite grit.

One large hopper for grain and one for mash and ample water are needed at each shelter.

See Chapter 25 for further information about range rearing.

8. Letting the chicks out of doors

Admit direct sunlight through large door or other openings whenever the day is sunny and quiet. Restricted outdoor range on the ground should be used with caution with large flocks. Large numbers of chicks on limited range quickly create a filthy soil. Wire or concrete runs may be provided, if desired.

Smaller flocks in *colony house brooding* should be allowed outside and the houses moved, if need be, to prevent soil contamination. Chicks in small houses need to escape from an excessively warm room. If a yard is necessary, enlarge the outside yard occasionally as the chicks grow. Place boards between the runners to prevent the chicks from getting under the house for a few weeks.

If *clean ground* is not available, let chicks out on platforms of ¾-inch mesh wire, suspended 1 foot above the ground, or on concrete.

9. Training the chicks

Chicks follow natural tendencies. To brood successfully one should be familiar with these tendencies and build a training program that gives maximum benefit. About all that is involved is to make important changes slowly, thus leading chicks on to doing what is best for necessary development and disease prevention.

Enlarge the space each 2 days, and on the fifth day they will find their way back to brooder warmth from 15 to 30 feet away.

Move waterers toward the wire-top frame and shortly they will be using it.

Provide a 10-watt all-night light; then, if separated, the chicks can find their way to the warmth and avoid huddling and smothering.

In about 2 weeks place perches 1 foot above the floor. Many chicks will be using these perches when 4 weeks old.

When the chicks reach 6 or 7 weeks of age, the heat usually may be discontinued. Leave the stove in the house, however, for a few days to be used in the event of a cold snap or cold wet weather. Now the pullets are ready for the range with its abundant air, perches, large feeders, and waterers.

FIG. 265. A growing bird suffering from perosis or slipped-tendon disease. Manganese sulfate, $\frac{1}{4}$ lb. thoroughly mixed in 1 ton of mash, greatly reduces the number of chicks in a flock having this trouble. Courtesy Dr. L. C. Norris, Cornell Univ.

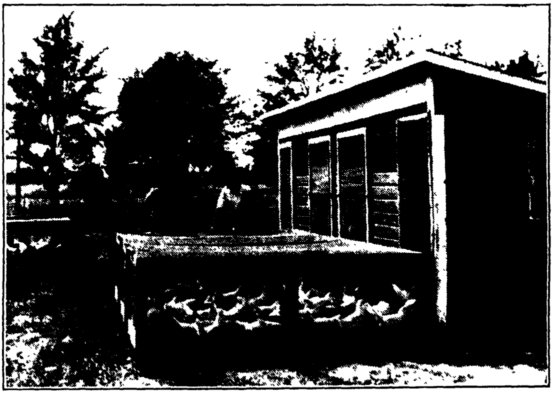


FIG. 266. A method of yarding chicks when necessary to keep in confinement. The yard is movable and is easily taken apart for storage. Worms, coccidiosis, limited range, or loss by foxes may require the use of such yards.

10. Brooding with the hen

Natural brooding offers a relief from many of the trials of artificial brooding and may be used where only a few chicks are reared. If a large number are brooded, the cost of equipment and labor is considerable and the artificial method is to be preferred.

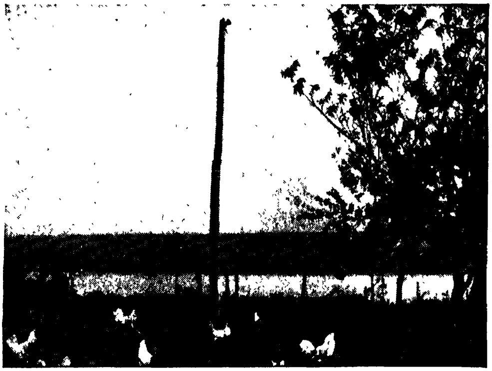


FIG. 267. A device for catching hawks, crows, or owls that annoy and capture chicks. A pole provides a place for the birds to light. Set a steel jump trap and place on the top of the pole. Fasten the trap to the pole. This device should not be used unless crows and hawks are bothering the flock during the day, as other birds may be caught. Heavy spikes driven into the pole provide steps for climbing the pole quickly. Owls are caught at night.

A. Select the hen for brooding. Where several hens are set at the same time, the chicks should be given to those hens which appear to be the best sitters, and the other hens broken up or reset. Usually, the American varieties, Rocks, Reds, or Wyandottes, are the best mothers. The Mediterranean varieties are not dependable, and the Asiatics are too clumsy.

B. Number of chicks per hen. In very early spring, 12 to 15 chicks to each hen are sufficient. Later, 18 to 25 chicks may be given. The number will depend somewhat on the size of the hen and chicks.

Hens will not always accept chicks which they themselves have not hatched, particularly if they are of a different color. It is well, therefore, to place any extra chicks under the hen at night, if they are not of the same appearance; otherwise they may be given to her when hen and chicks are transferred to the coop.

C. Select a brood coop. The brood coop should be roomy and well ventilated. It may be built on skids or set on blocks of wood, stones, or bricks, to avoid the danger of having a damp floor. Build the coop 2½ or 3 feet square and about as high. The front may be wired or slatted, but should never be solid or of glass. A hood may be built on the front to protect it from sun or rain, but an opening should be provided above the hood and at the rear, near the roof, for ventilation.

D. Range and shade for comfort and safety. It is usually better to keep the hen confined during the forenoon, until the chicks are several weeks old. This prevents their being led through wet grass and insures plenty of feed. The chicks are better suited when given free range.

If it is necessary to confine them, the yard may be made of high boards at first and later of slats or wire. Shade should be provided.

E. Destroy the lice, mites, and disease germs in advance. Treat the hen with sodium fluoride before the chicks are given to her. (Pages 254 to 256.) Watch for lice, and repeat the treatment when needed. Spray or paint with a mite repellent, or, if the coop is sprayed with a coal-tar disinfectant or painted with Carbolineum, wash out with cold water afterward. (See page 257.)

GENERAL INFORMATION

1. Principles of brooding

It is desirable, though not always possible, to observe all the following rules in brooding.

A. Maintain a proper temperature. The brooder should be sufficiently warm to prevent the chicks from crowding. For the first few days, the chick's lungs are protected from the outside air only by the down and thin skin on its back. It is there that the cold is most quickly felt. If the brooder temperature is too low, the chicks push in under the others because a chick is warmer than the outside temperature.

The more pushing and crowding there is, the warmer the pile becomes and the more the chicks continue to crowd. As a result, smothering occurs, or the chicks remain standing and pushing, lose sleep, and develop poorly.

B. Provide pure air without drafts. The chick is a quick-growing, quick-breathing animal, requiring rapid digestive and assimilative changes, and therefore suffers seriously and quickly when closely confined and compelled to breathe impure air. Pure air is the cheapest and certainly one of the best means of producing vigorous stock. A constant change of air, without dangerous drafts, within the brooder compartment is necessary.

C. Give the chicks a wide choice of temperatures. After the first few days continuous high temperature saps the vitality. Fear of chilling the chicks often results in keeping the room and the chicks dangerously warm. Cool, fresh air is invigorating and healthful and the chicks enjoy it, if they can quickly get back to the heat. Because of this fact, the brooder house or room should be large enough to allow the chicks to find a temperature several degrees cooler than that under the hover. The biggest bump in a chicken's head is the "bump of location."

D. Remember that exercise is the elixir of health. A chick cannot develop normally under close confinement. The muscles and digestive organs need exercising. A range of temperatures and roomy quarters are incentives to exercise. No heat is more invigorating to the chicks than the animal heat created by active exercise in cool, pure air.

E. Hit the chicks with sunbeams. Sunlight is a splendid disinfectant, adds warmth, and makes the house cheerful. It

is indispensable. Too much heat and sunshine together may be injurious, however. Guard against this by ventilation and shade during very hot days.

During the first few days in early spring, it is necessary to let the sunlight shine through the glass windows. After that, the chicks are able to stand a cooler temperature and on fine days it is well to open the windows, so that part of the sunshine and its ultraviolet rays will enter the house through the open space. This combination of fresh air and direct sunlight has an almost magical influence on the growth and health of chicks, which cannot be secured in any other way.

F. Allow ample room for attendant. A system of brooding which provides space enough for the attendant to enter the brooder house to do the work is a great advantage particularly during bad weather.

G. Guard against fire. There is always a certain element of danger from fire wherever any heating device is used. Before purchasing inquire how the manufacturers have met this danger in their particular brooder.

2. Brooder house construction and range shelters

Write your state agricultural college for plans and bulletin material for brooders, range shelters, feeders for brooder and range use, and watering arrangements.

COMMUNITY SURVEY

1. What percentage of the farmers in your community brood chicks by the colony system? By the permanent brooder system?
2. Are houses or range shelters used for rearing?
3. What percentage use coal stoves? Oil stoves? Electric brooders? Radiant heat? Gas?
4. How many brood 300 or less under one stove?
5. How many brood more than 300 under one stove?
6. Are chicks given outdoor range during the brooding period by the best poultrymen of the community?
7. How do the poultrymen tell whether the temperature of the brooder is correct?

8. Outline the ration and feeding practice for chicks used by a successful local poultry keeper.
9. Is he using feeding oil, milk, and green feed in the mash, and unfiltered sunlight (not through glass)?
10. At what age are chicks allowed to go outdoors?
11. Do the time of year and outside temperature influence this? How?

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CHAPTER XXII

PREVENTING AND TREATING CHICK DISEASES, PARASITES, AND VICES

Little chicks, like little children, are subject to diseases and other troubles peculiar to their age. Because of the rapidity with which chicks grow, their serious troubles are concentrated over a few weeks, instead of several years as with children. Happy is he who handles chicks in such a way that these troubles are avoided, or who, after the flock is attacked, knows how to diagnose the symptoms and where to go immediately to find and correct the cause of the disorder. It is always best to go immediately to the cause of trouble and remedy it, at the same time giving treatment. The best way, of course, is to handle the flock so that troubles do not occur.

A chick, because it is a small thing, is subject to many disadvantages in life, and for the first several weeks its life is in constant danger. The troubles that arise may be due to defects in the breeding stock, to errors in the management of it, or to faulty incubation or brooding. Careful attention should be given each season to these possible sources of danger.

"An ounce of prevention is worth a pound of cure." After the chicks are hatched, many of the ordinary troubles may be prevented if care is given to the points mentioned in Chapters XXI and XXV.

GENERAL INFORMATION

Diagnosing and treating chick troubles

When we call a doctor and he comes into the patient's room, the first thing he does is to find out what is wrong. He deter-

RECOGNITION OF THE MORE IMPORTANT CHICK DISEASES IN THE FIELD *

Usual age in weeks	External symptoms	Internal symptoms	Disease suspected	Sections
0–3	Sudden deaths following exposure; huddling.	Congestion of lung and other organs, enlarged gall, leg bones soft, no food in intestinal tract, kidneys normal in size but pale, liver yellowish.	Chilling or over-heating (exposure).	
1 or less	Swelling in navel region; stunted; sudden death.	Tissue in navel region bloody or water-logged; adherent large egg yolk; enlarged yellow liver.	Navel ill (mushy chick disease).	(1)
0–3	Wet and dirty around eyes.	....	Sore eyes.	(2)
1–3	Whitish diarrhea; pasting-up; droopiness; gasping; sweating.	Large streaked liver; large cheese-like egg yolk; nodules on heart or in lung; air sacs normal; cheese-like material in blind guts; kidneys swollen.	Pullorum disease.	(3)
1–3	Yellowish diarrhea; pasting-up; droopiness.	Large egg yolk containing dirty-yellow fluid, enlarged gall.	Common diarrhea.	(4)
1–4	Dumpish, sudden deaths.	Swollen pale kidneys, whitish material on heart sac.	Gout.	(5)
2–4	Inward curled toes, lameness in both legs, squatting.	Good flesh, sometimes slight jaundice of breast muscle.	Nutritional paralysis, page 132.	
2–4	Running nose, watery eyes, gasping.	Mucus in mouth and nasal passages, occasionally yellowish air sacs of lungs.	Infectious cold (coryza), page 240. Infectious bronchitis, page 243.	
2–7	Large crops, droopiness, poor growth.	Thick whitish to grayish false membranes in crop; ulcerated gizzard.	Sour crop (fungous infection), page 249.	
2–8	Eyes shut. Gasping.	....	Gapeworms.	(6)
Any time	Coughing, sneezing, slight nasal discharge. Mortality very high. Twisted neck, partial or complete.	....	Newcastle disease, page 246.	

3–7	Bloody diarrhea.	Blind guts filled with blood or cheesy material, carcass anemic.	Bloody (cecal) coccidiosis.	(7)
4–	Diarrhea, droopiness, poor growth.	Reddish to whitish dots or streaks on the outside of intestine; swollen mucous membrane of intestine tinged with blood.	Intestinal coccidiosis, page 239.	
4–	Walking on hocks, shanks twisted, deformities of legs.	None in internal organs; tendons of hock joint misplaced.	Slipped tendon (hock disease, perosis), page 471.	
4–10	Lameness in both legs.	Thick joints, soft bones, crooked breast bone.	Rickets (vitamin D deficiency), page 132.	
4–10	Poor growth.	Prominent follicles, whitish membranes in esophagus; swollen pale kidneys.	Nutritional roup, vitamin A deficiency, page 130.	
6–	Lameness usually in one leg, droopy wing, paralysis of crop, blindness.	Enlarged leg or shoulder nerves, occasionally tumors.	True fowl paralysis, page 247.	
6–	Greenish diarrhea, poor growth.	Large cheese-like material in blind guts, cartwheel-like yellowish round areas in liver.	Blackhead.	(8)
Any time	Bloody toes, tail or abdomen.	....	Cannibalism, page 233.	
Any time	Blisters about head, comb, and wattles, later turning black and resembling warts.	....	Chicken pox, page 235.	
Any time	Plumage rough. Poor growth. Body thin. Pale shanks and beak. Inactive and weak.	....	Intestinal worms. Lice. Mites.	(9) (10) (11)
2–7	Head retractions. Somersaults.	Good flesh; body organs normal; small brain enlarged, watery, showing hemorrhages.	Crazy chick disease (Encephalomalacia) deficiency, page 135.	
June	Sudden deaths after ranging.	Rose chafers in crop.	Rose chafer poisoning.	(12)

* Taken largely from Bulletin 202, Storrs Agricultural Experiment Station, by permission of Dr. Erwin Jungherr.

mines this by means of certain symptoms which indicate to him the nature of the trouble. The poultryman is in exactly the same position with respect to the health and condition of his flocks. In his daily work with them he must be constantly on the watch for signs or symptoms of trouble. The preceding chart of the common symptoms of chick ailments will aid the poultryman in keeping on the lookout for troubles and in diagnosing diseases when certain symptoms are observed.

Diseases and troubles to which chicks are susceptible are discussed in this chapter and in Chapters XI and XII. The pages and disease numbers are given for quick reference.

1. Mushy chick disease (navel ill or omphalitis)

Losses from this disease are generally small. Infection of the navel may occur at time of hatching. No treatment is known. Prevention is recommended by the formalin evaporation method, page 419, and by thoroughly cleaning and disinfecting the incubators between hatches.

2. Sore eyes

Frequently a flock of chicks will develop sore eyes. The eyes water freely, dust clings to them, and hence the eyes have a dirty, pasted appearance.

The trouble results from material getting into the eyes and irritating them.

Using fine chaff or barn floor sweepings for litter is a frequent cause of the trouble. Certain seeds have prongs which are sharp and rough. Because of this, hay chaff is not a desirable litter.

When litter becomes dirty, dusty, or damp, it should be renewed.

3. Pullorum disease

This is very troublesome in many sections, but is seldom found in others. When a flock of chicks is once infected, the disease proves to be very destructive. Most of the mortality

occurs during the first week, although losses may continue for 3 or 4 weeks or longer, in fact throughout life.

Symptoms: The symptoms are the same as those listed under ordinary diarrhea, except that there is sometimes more of a tendency for the chick to utter a peculiar chirp or twitter when attempting to void the excreta. This is apparently a cry of pain. The chick breathes hard. The presence of the unabsorbed yolk and the fact that the chick does not grow properly

FIG. 268. Chicks infected with pullorum disease.

cause the body to assume a short, round, blunt appearance which, with the drooping wings and sleepy attitude, enables one quickly to detect the presence of the disease (Fig. 268).

Cause: Pullorum disease is caused by the organism called *Salmonella pullorum.* The chicks that start the trouble are infected with the organism when hatched. This occurs as follows: When a chick that is infected with the organism survives and develops into a layer, the organism may, and usually does, localize in the ovary, which is the principal seat of the trouble. When an egg is laid by one of these "disease carriers," the organism is in the yolk. Hence the chick when hatched has the disease germs in its body and on its down, as *Salmonella pullorum* is present in the liquid surrounding the embryo in the egg. The diseased chick quickly spreads the infection to the other chicks in the incubator through the droppings, and through their breathing the germ-laden air, especially during the first 4 days (Fig. 269).

Remedy: The only sure way to prevent the disease is by using eggs from stock that is not infected. If no trouble has been experienced, it can come only through the introduction of new stock, chicks, or eggs.

A means of testing hens has been found by which those infected with pullorum disease can be detected. The "slow tube agglutination test" is a blood test of each individual; it is made in a laboratory. Blood is drawn, serum is separated,

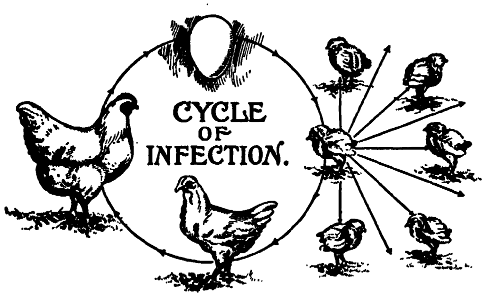

Fig. 269. Diagram showing how pullorum disease perpetuates itself in the breeding stock. From Univ. of Connecticut.

antigen is added, and the results are read. Several days are required to make the test.[1]

Experiments prove that the test is reliable, but that it may be necessary to test two or three times, in order to locate definitely all birds having the disease. One test will tell whether the flock is infected; if it is found to be so, other arrangements may be made accordingly.[2] Breeders should be tested if chicks from the flock have died from a disease diagnosed as pullorum disease. It would be unwise to hatch eggs from breeding stock known to be infected.[3]

[1] A description of the test will be found in the Report of the New York State Veterinary College, Cornell University, 1925–1926, pages 131–144.

[2] Follow directions issued by the laboratory of poultry diseases in your state.

[3] Several methods of testing have been tried. The whole blood rapid test is nearly as accurate as the slow tube test, and is in wide use

Although the appearance of the infected chick is a good indication of the presence of the disease, the only sure way of determining whether chicks have pullorum disease is through a bacteriological examination.

There is no known cure for the chicks that have the disease. All the sick chicks should be removed immediately and destroyed, and the house and quarters thoroughly cleaned and

Fig. 270. The caeca showing symptoms of acute coccidiosis.

disinfected. As new cases develop, remove them and clean and disinfect daily until the trouble seems to have disappeared. Pullorum organisms are comparatively easy to kill by disinfection.

After each hatch, fumigate the machine or room. (See page 421.) For each 100 cubic feet of space, place 35 cubic centimeters of formalin in a large earthenware dish. Add 17.5 grams of potassium permanganate. Close the room or machine

because of its rapidity and reduced handling of birds. Results are read before the bird is released. The rapid serum test consists in applying antigen to the serum and reading soon afterward. It is nearly as accurate as other methods.

tight for 30 minutes. If the entire room is to be fumigated, open the machine doors. Keep the incubator at hatching temperature while fumigating. The air should be highly saturated with moisture. Air the machine or room well before entering.

4. Ordinary diarrhea

Symptoms: The first symptom noticed in trouble of this kind is a listless attitude; the wings droop, and the chick appears sleepy. The feathers around the vent become pasted up with a whitish or yellowish material, which may accumulate into a large amount. Usually there is a considerable mortality, several chicks dying at night, under the hovers. The chicks lose their appetite and fail to grow; in fact, they appear to become smaller.

This disease is often confused with pullorum disease.

Cause: The trouble is due principally to overheating, chilling, or other mismanagement which lowers the resistance and permits certain bacteria to gain a foothold.

Remedy: Correct the conditions. Provide clean brooding. Flush the chicks by adding 1 or 2 level teaspoonfuls of Epsom Salts to a gallon of water or by adding 20 per cent dried skimmilk to the mash. Give one or the other for ½ day.

Get chicks outdoors on sod, or place sods in the houses. Supply green feed; it is nature's best corrective for digestive troubles.

5. Gout

This disease is thought to be due to insufficient vitamin A or to an excess of protein.

6. Gapeworms

Symptoms: The neck is stretched out and the chick gasps for breath. It may shake its head and cough. Often it will stand or sit for hours, with its eyes shut, gasping at regular intervals.

Cause: The trouble is caused by a worm which fastens itself to the inside of the windpipe, or tracheal tube. It causes inflammation of the tube and death by suffocation.

The worm is in two parts, the male and female being joined together. The size when full grown is ½ to ¾ inch.

The infected chicks cough up worms, which later disintegrate, releasing the eggs on the soil. These eggs may later be picked up from the ground by other chicks. It has been found that mature turkeys play an important part in the spread of this worm.[1]

Remedy: Raise chicks on other ground for 1 or 2 years and keep mature stock from the rearing range. Cultivate and lime the soil and sow a crop.

Individual treatment: The worms may be removed by holding the chick's legs between the knees, stretching the neck upward, and holding the beak open with one hand, while with the other a twisted horsehair, having a loop at the lower end, is pushed down inside the windpipe. Twist slowly as it is pushed in, and when in the full length draw out slowly, twisting at the same time. The worms may be attached to the hair and the chick relieved. Instead of the horsehair, a quill feather or stripped timothy head is sometimes used.

A piece of red-top grass is excellent for the purpose. Remove all side projections except the last four or five near the tip. Shorten these to about ¼ to ½ inch in length, and use as described above.

Chemicals inhaled by chicks have not been found effective in removing gapeworms, except in a laboratory test where barium antimonyl tartrate was used. This was 98 per cent effective.[2]

[1] Ransom, "The Turkey an Important Factor in the Spread of Gape Worms," Bulletin 939, U. S. Department of Agriculture.

[2] Wehr, Harwood, and Schaffer, "B. A. Tartrate as a Remedy for the Removal of Gapeworms from Chickens," *Poultry Science*, January 1939.

7. Acute or caecal coccidiosis (E. tenella) [1]

The acute form is a common disease. Two important sources of coccidiosis are the soil and old birds which harbor the disease without showing any external symptoms. The adult carriers release the organisms through the feces, contaminating the soil and surroundings. The organisms may live outside the body for several months. Under moist, warm con-

FIG. 271. A flock of chicks suffering from acute coccidiosis. Note two nearly dead lying on the floor and drooping wings on chick (lower right).

ditions they go through a necessary period of development (24 to 48 hours), after which they can infect chicks if picked up.

Symptoms: In mild cases, the chicks appear listless and droopy, the feathers rough and shanks and beak pale. The chicks die, according to the severity of the disease, from one to several each day. In bad cases the chicks may appear normal in the morning and be dead in 12 to 24 hours. The droppings are frequently bloody. Bloody droppings may not be positive evidence but are very indicative of the presence of coccidiosis.

Post-mortem examination usually shows enlarged caeca. The color of the contents varies from a bloody brown to a light yellow, and the consistency from a pasty to a cheesy

[1] Chronic coccidiosis is discussed on page 239.

mass. The only definite way of determining whether or not the disease is present is by a microscopic examination of a minute quantity of the caecal contents (Fig. 272). There is seldom any difficulty in diagnosing the disease by the appearance of the chicks considered in relation to their age.

Cause: Acute coccidiosis is caused by a microscopic organism which works in the intestines, destroying the mucous membrane of the caeca. The infection must enter the body through the mouth, large quantities of the parasites (several thousand) being necessary to produce trouble. Coccidiosis, once started, spreads rapidly.

Remedy: There are three generally accepted feed treatments. (*a*) Milk flush. Mix regular mash and dry skim-milk at the rate of 6 pounds to 4 pounds respectively. Feed for 2 to 3 days. Then clean houses well. (*b*) Flowers of sulfur. (*c*) Sulfaguanidine.

Recent recommendation:

1% sulfaguanidine 5% sulfur	Feed 1 day in mash
5% sulfur	Feed next 4 days.

Prevention is best. Avoid damp places in the brooder by placing the water dishes on wire-covered stands, by stirring the litter daily, and by increasing window or ventilator openings to permit moisture to escape.

8. Blackhead

Losses from blackhead among chicks are not great. The organism is carried by old birds and given off in the feces either by themselves or in the eggs of caecal worms.

Treatment, if necessary, is the same as for acute coccidiosis.

9. Intestinal worms

(See pages 257 and 262.)

10. Lice

(See page 252.)

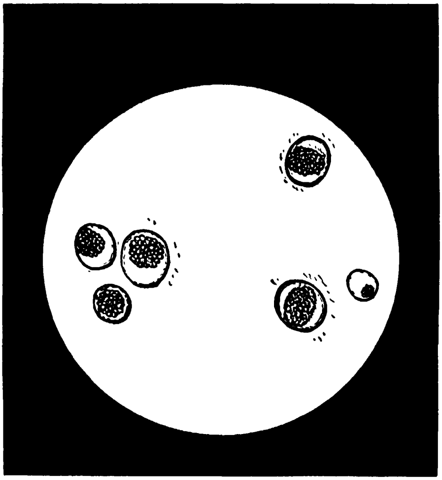

FIG. 272. Coccidiosis. The oöcyst or seed stage (magnified 950 times) found in the intestinal contents and in the soil. The oöcyst when taken into the digestive tract breaks up into other bodies which attack the epithelial cell lining of the duodenum or caeca.

FIG. 273. Vaccinating for chicken pox by puncturing the web of the wing.

11. Mites

(See page 254.)

12. Rose chafer poisoning

In localities where this trouble has occurred it may be necessary to confine the chicks to the brooder houses during the 1 or 2 weeks chafers are prevalent.

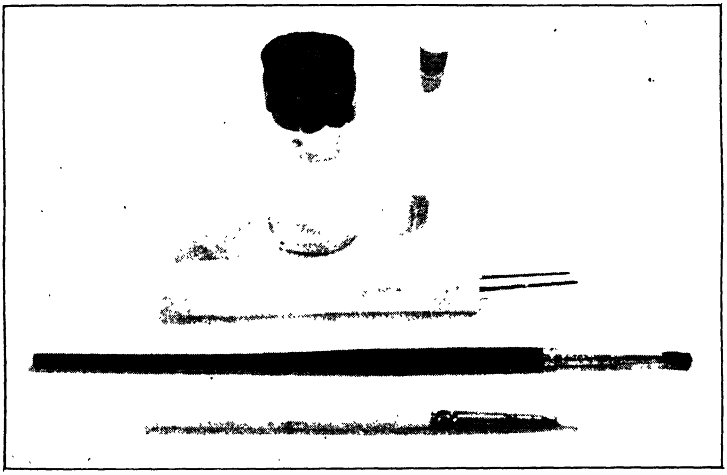

FIG. 274. Equipment used in vaccinating for chicken pox by the feather follicle and the stick method. From top to bottom, distilled water and scabs, needles mounted for use in the stick method, and brushes for the follicle method.

COMMUNITY SURVEY

1. What causes the greatest chick loss in your locality?
2. At what age does the greatest chick mortality occur?
3. List the diseases that are prevalent.
4. List the mechanical ways in which local poultrymen have lost chicks.
5. What means have been taken to prevent these mechanical losses?
6. Ask the local veterinarian if he has had occasion to use the agglutination test, and how he does it.
7. What per cent of the chicks are missing or die during the rearing season?

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CHAPTER XXIII

CAPON PRODUCTION

A capon is a male bird with the reproductive organs removed. It bears the same relation to a cockerel as a steer does to a bull, a wether to a ram, or a gelding to a stallion.

There are two main reasons for caponizing. It may be done for financial gain. It also enables the poultryman to hold birds for table use for a considerable period, with less trouble and expense than if they were not caponized.

Capons are preferred by many average-sized families when high-quality poultry meat is to be served. The quality of flesh is unsurpassed, and often capons are quoted at the highest poultry meat prices.

The business has not developed extensively in the southern states, compared to the North where demand appears greatest.

Producing and selling "started capons" is a new and profitable business in certain sections. Cockerels are caponized at 2 weeks of age and shipped to customers at 3 to 4 weeks.

Raising capons may be a profitable side line when "straight-run" heavy breeds or crossbreds are grown for egg production, or a few cockerels or "started capons" may be grown as a side line or as a full-time enterprise.

Operations:

1. Selecting cockerels.
2. Preparing the cockerels for the operation.
3. Preparing the caponizing board.
4. Arranging materials.
5. Choosing a place for operating.
6. Performing the operation.

7. Caring for the birds after the operation.
8. Preparing capons for market.
9. Marketing capons.

General information:

Caponizing instruments.
Characteristics of a capon.
Breeds for caponizing.
What is a successful operation?
Possibilities in capon production.

1. Selecting cockerels

Select only strong, vigorous, healthy birds for caponizing. Good results cannot be expected from inferior stock. Birds that have been bred for large size and high-quality meat production are best.

Age and size. Plymouth Rocks, Wyandottes, Rhode Island Reds, Orpingtons, and similar breeds are likely to be in condition for caponizing at the age of 2 to 4 weeks, when the cockerels weigh about ¼ to ¾ pound (Fig. 275*A*). With the Brahmas, Langshans, Jersey Giants, and other heavy breeds, the proper age will be about 4 to 5 weeks, and the weight under 1¼ pounds. Leghorns mature rapidly sexually and should be operated on when weighing ½ pound or less.

For best results, the testicles should not be much larger than a large kernel of wheat, in the case of any breed, when the operation is performed.

2. Preparing the cockerels for the operation

Keep the cockerels in a well ventilated coop or pen. Discontinue the food approximately 14 to 18 hours before the operation, but water may be given. If a bird has not been properly starved, the intestines will keep pushing out into the opening, and the operator will experience considerable difficulty and probably will fail to locate the testicles. Starving also results in less bleeding.

3. Preparing the caponizing board

There are many types of caponizing boards and tables. Some are on a pivot, so arranged that the surface may be tipped at any angle. A board which is serviceable, and at the same time easily and quickly constructed, is made as follows (Fig. 275*B*):

Fasten two boards of ⅜- or ½-inch material together with cleats on the under side, making a surface 1 by 1½ feet. Along the upper 1½-foot edge, on the under side, nail a 2-inch strip edgewise. This allows the board to slant when placed on a box or barrel.

Nail a 2½-inch "ship cleat" on the lower left-hand corner of the upper surface. The center of the cleat should be about 5 inches from the left side and it should be nailed on the lower edge. Three and one-half

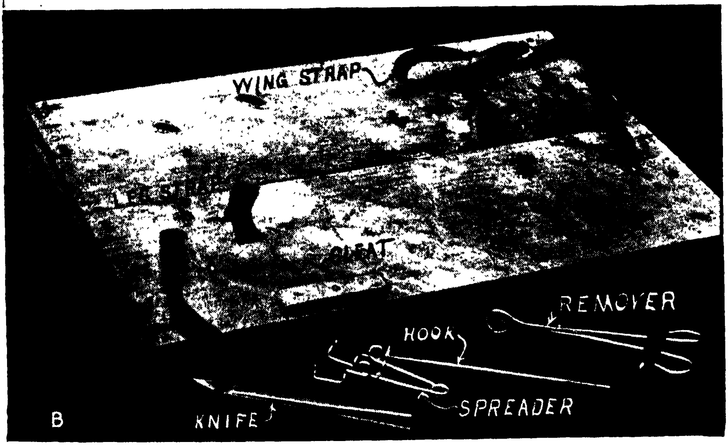


FIG. 275. *A*, A Rhode Island Red cockerel ready for caponizing. *B*, A caponizing board.

inches from the lower edge and the same distance from the left edge, cut an opening through the board, parallel to the bottom and large enough to permit a $\frac{1}{2}$-inch strap to slide easily. One and one-fourth inches above this cut, tack the end of the strap and allow the loose end to go through the opening in the board.

A. B.

FIG. 276. Caponizing frame. *A*. Dimensions of the frame; *a*, leather string for the feet and *b*, for the wings. *B*. Placing the loop over the wings.

Lay a bird, of the average size of those to be caponized, on its left side on the board the legs to the left and the hock joint near the lower left-hand strap.

Stretch the bird diagonally toward the upper right-hand corner. Take a strap $1\frac{1}{2}$ feet long, with sliding buckle, and nail the buckle end to the board about 2 inches to the right of the junction of wings and body.

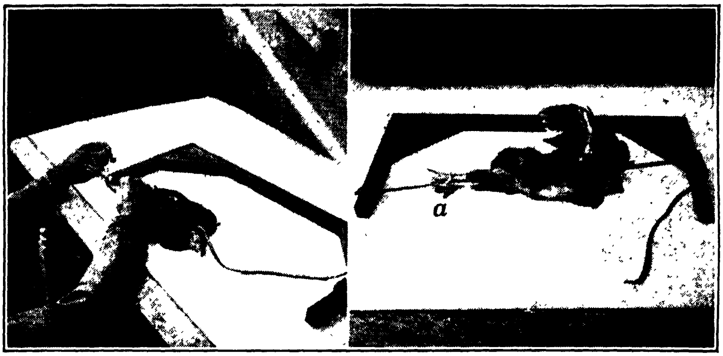
The board is now ready for use.

4. Arranging materials

The surface of the caponizing board, or of the box or barrel on which the bird is to lie, should be about waist high and sloping down toward the operator. A box or other surface should be at the right and about the same height, to hold

the instruments. Some operators prefer to place them just under the caponizing table. The location of the instruments is largely a matter of personal choice, and the operator will quickly find where they are most convenient.

Arrange the instruments in the order of their use, as follows: (*a*) knife; (*b*) spreader; (*c*) hook; (*d*) remover (Fig. 275*B*).



C. D.

FIG. 277. The caponizing frame. *C*. Fastening the feet. *D*. Ready for the operation.

A small dish of water will be found convenient for moistening the feathers where the cut is to be made.

Place a dish of disinfecting solution, such as 5 per cent solution of carbolic acid and water, near by, in which the instruments may be dipped.

5. Choosing a place for operating

Either too much or too little light is unsatisfactory. Direct sunlight is dazzling, and a better view of the interior of the body may be had by keeping under the shade of a tree, or just inside of a barn or other building, where the direct sunlight cannot shine on the bird. If in a building, stand with the back toward the light and in a position which allows the light to shine into the body of the bird. On a cloudy day, or when the

sun is not bright, the best place may be out of doors. A very cloudy or a dark day is likely to make the operation impossible.

6. Performing the operation

It is best to practice first on a dead bird until one is familiar with the operation. Fasten the bird to be caponized on the board as follows: Pass the legs under the lower left strap, having the right leg above the left, to stretch the muscles of the body. Pull the strap tight, bring the strap up over the lower edge, and slip under the cleat. Pass the upper right strap under and over the wings and through the buckle, drawing up until the bird is held firmly.

The board may now be moved into any position (Fig. 278*A*, *B*), and the bird will be stretched in the best manner for operating.

The operation consists of several definite steps which should be followed in regular order after the bird is laid on the caponizing board.

(1) Remove the feathers in front of the hip. If those remaining persist in getting in the way, moisten them with water.

(2) Place the middle finger of the left hand on the hip and draw the skin to the left by pressing with this finger (Fig. 278*C*).

(3) While still holding the skin back with the middle finger, use the forefinger of the same hand and locate the last two ribs nearest the hip. Keep the finger there as a guide (Fig. 278*C*).

(4) Locate a point between the last two ribs and about ¾ inch below the backbone, and, with the sharp edge of the knife toward the operator and the handle sloping away (Fig. 278*C*), and while the skin is still drawn back, press the point quickly through the skin and the flesh ⅛ to ¼ inch. This drawing of the skin results in completely covering the opening between the ribs when the skin slips back after the operation has been completed.

If the cut is made between the second and third ribs, the

A. Note position of legs and the straps holding legs and wings.

B. The bird on the board ready for the operation.

C. Ready to cut. Note position of hands and knife. Point of knife is inserted between the two ribs nearest the hip bone.

FIG. 278.

lungs may be injured and it may be impossible to remove the lower testicle. If made between the last rib and the hip, it is too far back for easy work and may cut the large muscle controlling the leg, thus injuring the bird.

(5) With one or two more cuts, make an incision about 1 inch in length, keeping between the ribs, cutting through flesh and into the body cavity. (If the birds are properly starved there is little danger of cutting the intestines. One or two good clean cuts are better than several hacking cuts which do not go through to the body cavity.)

(6) Place the spreader with each hook around a rib. Push the points of the spreader together, insert them, and then turn the handle to the rear and let them hold the cut open $\frac{1}{4}$ to $\frac{1}{2}$ inch. Now, with the knife, continue to cut between the ribs until the opening is about one inch long. Do not cut too near the back as the arteries are near that point. Pull the wound apart gradually with the spreader, until an opening $\frac{1}{2}$ to $\frac{5}{8}$ inch is made. Fasten the spreader jaws to hold at that point (Fig. 279*A*). On the smaller birds, care must be exercised not to open the spreader so far as to break the ribs.

(7) With the hook, tear away the thin tissue covering the intestines (Fig. 279*A*).

The upper testicle should now be seen, a light-colored, elongated body about the size of a kernel of wheat or a small bean, lying near the back and against an artery (Fig. 279*B*). The under testicle should be removed first, if both are to be removed from one side. Then, if any bleeding occurs, the upper one may still be seen; whereas if the order of removal is reversed and bleeding occurs, it may be impossible to secure the under testicle without making an incision on the other side of the bird.

The most difficult part of the operation is to secure the lower testicle. The exact way to go about it will depend on the particular style of remover used. The following method applies to the style of instrument known as the "Farmer Miles" remover (Fig. 275*B*).

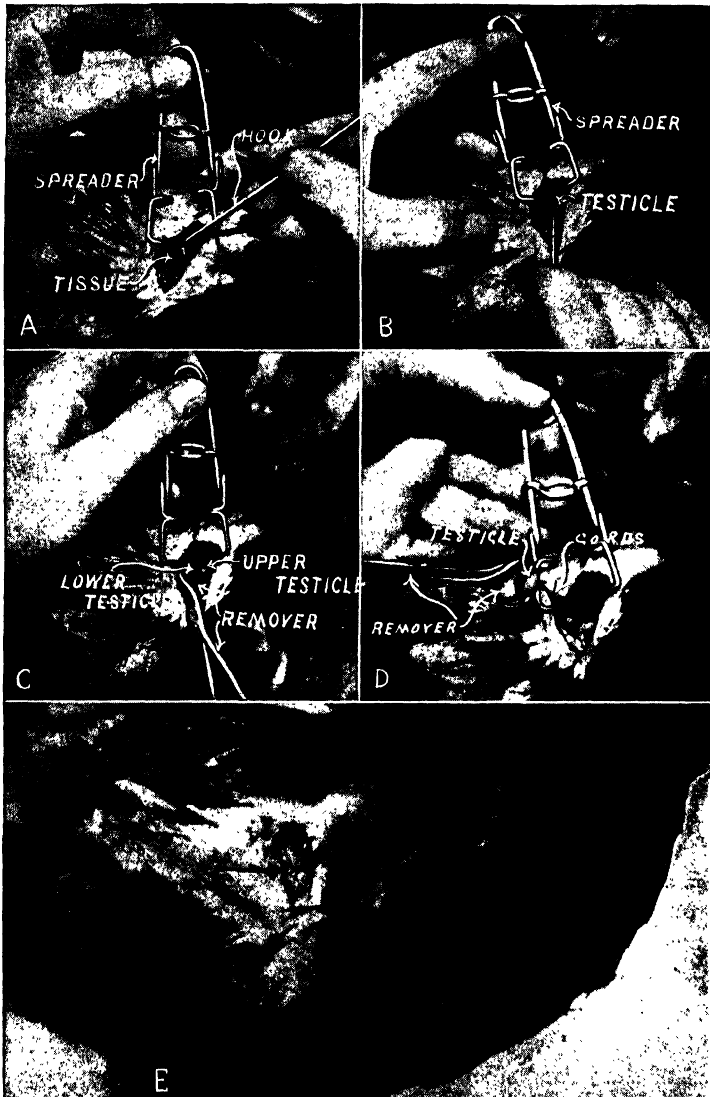


FIG. 279.

A. Using the hook to tear the tissue covering the intestines. *B*. Note position of the upper testicle. *C*. Note upper testicle. The lower testicle is grasped by the remover, and is ready to be torn loose. *D*. Removing the testicle. Note the cords and tissues connecting the testicle with interior. These should be removed or cut off. *E*. The operation com-

(8) With the remover, reach under and slightly to the rear of the upper testicle, press upward carefully, and, with the instrument closed and using the ring on the remover, pull the under testicle into view.

(9) Still pushing carefully upwards, open the remover ⅛ inch. Let the testicle slide off the ring and catch on the solid lip beneath. Then push in carefully and close the remover (Fig. 279*C*).

(10) Slip the remover sidewise once or twice to let any bloodvessels slip out, then close firmly, twist the remover to wind the cord holding the testicle, and gently tear it out (Fig. 279*D*). The testicle and its sac should be removed from the body cavity.

(11) Remove the upper testicle in the same manner.

If considerable difficulty is experienced in securing the under testicle, the bird may be turned over and a cut made in the left side, whereupon the testicle may be easily removed. Some persons always remove from each side. It is usually better to learn to secure both testicles from one side, as this method consumes less time and requires less cutting of the bird.

(12) Release the bird. The skin should slide forward and the muscles completely cover the cut in the body (Fig. 279*E*).

Mark the capon, either by cutting off a toenail or slitting the web of the foot with a knife, by filing a small notch on the top of the upper beak, or by wing or leg banding the bird.

7. Caring for the birds after the operation

Place the birds in a pen by themselves for a day or two at least. Supply food and water. Regular rations of grain and mash may be given if the birds seem unaffected by the operation. If they appear dumpish, soft food may be given for 2 or 3 days. After a few days, they may be turned in with the rest of the young stock. A separate range from the uncaponized male birds, however, is desirable.

Within 24 hours the wound made in caponizing will be

closed, and in a few days only a shiny scar will show where the cut was made.

Wind puffs. Watch the young capons carefully during the first week. A few of them may bloat near the part of the body where the cut was made, and, if not attended to, the bloating may extend down the legs and over that half of the body until the bird is deformed. When any swelling is noticed, pick up

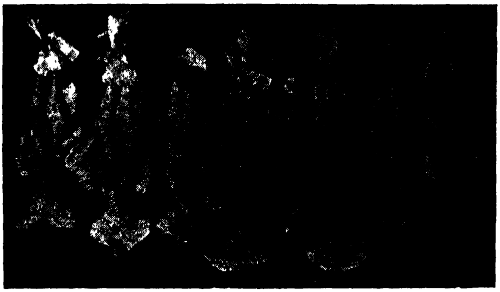


Fig. 280. Capons plucked and ready for market. From N. Y. (Geneva) Agr. Expt. Station.

the capon and, with a coarse needle or sharp point of a pocket knife, puncture the skin and let the air escape.

8. Preparing capons for market

Capons should be especially fattened about 10 days to 2 weeks before marketing. (See Chapter XV, for fattening rations and method.) Most markets require that the capons be killed and picked and sent to market as dressed poultry. Special methods of preparation may be needed to meet the requirements of certain markets. Capons may be plucked by the dry or wax methods. Formerly certain feathers were left on capons to distinguish them more easily (Fig. 280). More recently the market is demanding all feathers removed. Undeveloped comb and wattles mark the dressed bird from the ordinary roaster.

9. Marketing capons

Capons are usually marketed plucked and packed in boxes when many are sold. For local or small sales they may be packed in baskets.

GENERAL INFORMATION

Caponizing instruments

The particular type of instrument used is an important, but not a determining, factor. It is more a question of becoming accustomed to a certain kind of instrument, as the operator will be likely to do better work with the one he is in the habit of using than with some other. The four instruments mentioned in section 4 of this chapter are the main ones needed.

Several kinds of caponizing sets may be found advertised in the poultry periodicals. The various sets differ mainly in the type of remover.

One type of remover consists of a hollow tube, with the lower end compressed, leaving two small openings through which a fine wire is run. The wire is placed over the testicle and drawn up until the spermatic cord is cut. Another type consists of two halves of a small spoon so arranged that the half having an inner cutting edge will slide over the other and sever the cord, after the spoon has been slipped under the testicle and the cord carried between the jaws. Still another type is a spoon with a slit in it. This is operated like the one described above, but the cord is severed by twisting.

A type which is successful if it is carefully used, and which tears, but does not cut, is known as the "Farmer Miles." This consists of two arms hinged scissors-fashion. One arm terminates in a flat, thin surface about ½ to ¾ inch in diameter. The other terminates in a ring which fits over the outside edge of the flat surface of the other arm when closed.

There are one or two variations of the "Farmer Miles"

type of remover on the market. In general, this type is easy to operate after one becomes accustomed to it.

Homemade instruments may be used if desired. The knife, a hook, and a spreader are necessary, but may be made or assembled if an entire set is not purchased. Any small, sharp blade, such as that found on a jack-knife, will answer for the

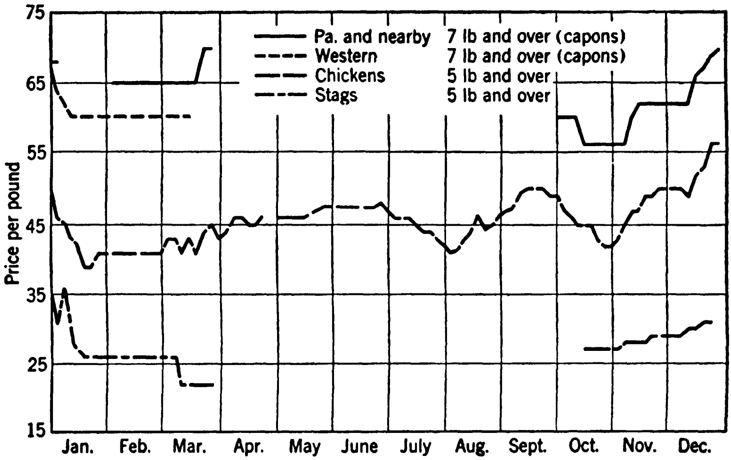


FIG. 281. Prices of dressed capons, chickens, and stags, 1947. Figures taken from the daily quotations in *Producers Price Current.*

knife. A hook may be made by bending the end of a piece of hay-baling wire at right angles and filing this end until a sharp hook a little less than 1/8 inch is obtained. The spreader is more difficult to make, but may be bent from a piece of wire having a spring to it. Use a wire about 8 or 9 inches long. On each end make a hook by first bending back 3/4 inch of the wire at right angles. Starting 1/4 inch back from the main wire, bend the other 1/2 inch down in the form of a semicircle. File the end blunt. When both ends are finished, bend the wire in the center until the backs of each semicircle are within 1/2 inch of each other. There should be sufficient spring to the wire to open the cut as desired. (See Fig. 279.)

A blunt probe is sometimes useful in holding back the intestines. The handle of a spoon will usually do this satisfactorily.

Characteristics of a capon

A true capon does not crow, but clucks and sings like a hen. The growth of comb and wattles practically ceases, and the head thus takes on a long, undeveloped appearance. The hackle and saddle feathers continue their development. The bird loses all desire to fight, becomes very quiet and peaceful, stands confinement well, does not bother other birds, and will often mother a brood of chicks.

Capons keep increasing in weight for several months after the cockerels of the same age and breed have practically completed their growth. While the flesh of the cockerel commences to take on hard, "staggy" qualities, the capon retains the fine flavor and texture of flesh characteristic of broiler meat or of the flesh of a pullet just before she comes into laying. Capons are easily fattened.

Breeds for caponizing

The wholesale market for capons pays a higher price for birds weighing 9 pounds or over. Markets differ in the size of capon desired. It is always well to cater to the demands of a particular market and select such varieties as command the highest price.

In most American markets, yellow skin and legs are preferred. (See Chapter XXVII for skin color.)

Since the highest-priced capon market opens about January 1, and continues until about Eastertime, it is possible to select the heavier, slower-maturing breeds if a heavy capon is desired. For a capon weighing 9 to 12 pounds or higher, the Light Brahmas, Orpingtons, or similar heavy varieties may be used. The Black Jersey Giants have been developed for a large roasting bird and make heavy capons. The Langshans are heavy and may be used. The American breeds, such as

the Plymouth Rocks, Rhode Island Reds, and Wyandottes, produce a smaller capon, weighing 7 to 10 pounds each.

The Leghorns, which are especially good for the production of small broilers, make a small capon, weighing 5 to 7 pounds. Such a capon is too small for the general wholesale market, and may not demand the highest prices. Generally it would be more profitable to sell the Leghorn cockerels and buy others of a heavier breed to caponize for market or family use.

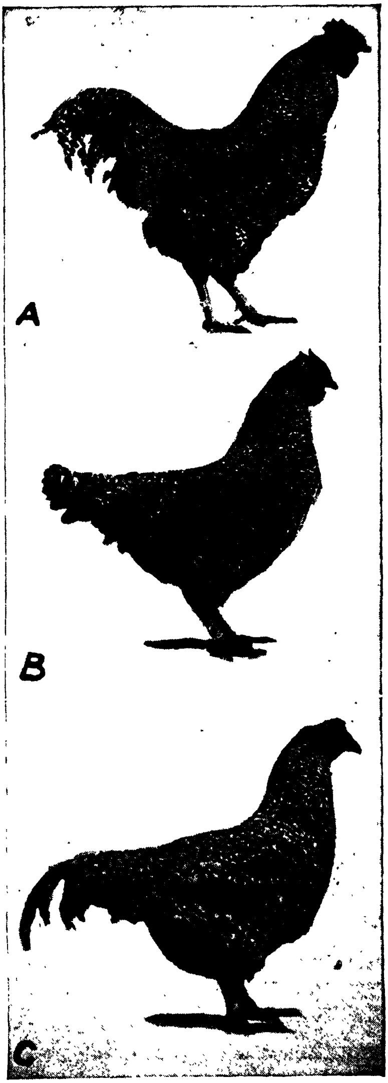


FIG. 282. *A*. Cockerel. *B*. Slip. *C*. Capon. From N. Y. (Geneva) Agr. Expt. Station.

Various crosses between these varieties, and of these varieties with others, are regularly made by some growers, in the belief that larger size and more rapid growth are secured than would be the case if any single pure breed were used. There appears to be some reliable evidence to support this policy. On the other hand, greater variation in size and type of progeny is likely to result from crossing. Moreover, it is necessary to mate to-

gether two pure breeds each year in order to secure the possible benefits of crossing. Most capon growers will be likely to follow the practice of using a pure breed.

What is a successful operation?

If any of the testicle is left in the bird, it will grow, and the bird will be neither capon nor cockerel. Such a bird is known as a "slip" (Fig. 282*B*). It retains cockerel characteristics,

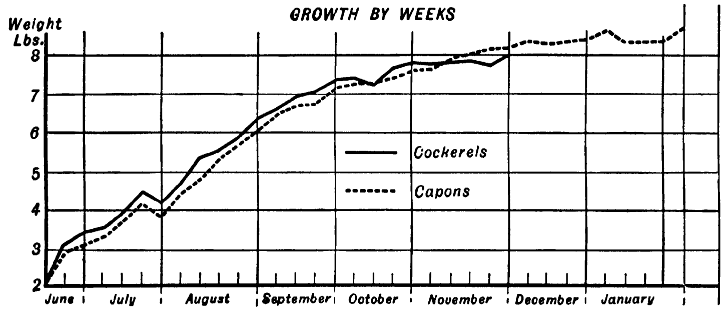


FIG. 283. Growth by weeks of capons and cockerels at Cornell. Note the cockerels were ahead until about 6 months of age, at which time the capons took the lead. Note sharp increase in growth of both capons and cockerels when placed in the fattening pens just before marketing.

but is seldom able to reproduce. Ordinarily, a skilled person will make only a small percentage of slips, about 3 to 5 per cent being the average. An increased number is likely to result from any of the following conditions: amateur caponizing, lack of practice, insufficient starving of the birds, use of a wrong type of instrument, and operating on too large birds.

If an artery is cut during the operation the bird will bleed to death very quickly. When this occurs the bird may be used for food, as the bleeding is as well done as though bled at the mouth. With experts, the mortality is likely to run as high as 5 per cent, and with amateurs it may be considerably higher. Frequently, no birds are lost as a result of the operation.

Possibilities in capon production

The production of capons may be an established farm or poultry business, or a means of serving customers who are already buying some of the farm products.

There are no exorbitant profits in the production of capons. Both capons and cockerels will make about the same rate of growth until the cockerels approach maturity, when the capon usually makes slightly better gains on about the same amount of feed (Fig. 283). This means that the flesh is somewhat more economically produced at that time, and because of the higher price per pound which usually prevails for capons, the net return is greater.

When capons can be farm-reared or have the advantage of practically free range the gains will be much greater.

Careful records kept by the capon grower, including data from which one may determine the profit per pound and per bird, and a comparison between capons and broilers, will do much toward helping the individual to determine if the practice is adapted to his particular conditions.

COMMUNITY SURVEY

1. How are surplus males disposed of by the largest poultry keepers in the vicinity?
2. Are there any poultrymen who make a practice of caponizing surplus males?
3. At what age do they caponize?
4. What instruments are used?
5. What breeds give best results?
6. What is the local charge for caponizing?
7. Are the capons given free range or confined?
8. How long are the capons held before marketing?
9. What is the difference in price received for capons and cockerels?
10. What are the reasons given for this difference?

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BOTSFORD, H. E., "Capon Production," New York State College of Agriculture Extension Bulletin 143, 1944.

PAYNE, L. F., "Capon Production," Kansas State Agricultural Experiment Station Bulletin 274, 1936.

CHAPTER XXIV

MAINTAINING EGG PRODUCTION DURING THE SUMMER

An important problem which every poultryman has to face is keeping the birds in the best physical condition and in continuous production, at least during June, July, August, and September. There is a tendency, under most conditions, for production to drop during these months.

Very frequently, flocks are culled and a large percentage of the birds removed as low producers, when the real trouble is not with the birds but with the conditions under which they are kept. Good birds will often continue to lay notwithstanding adverse conditions, but medium and poor birds are often unable to do this. Many of the birds that cease to lay because of the handicaps of the season and lack of care would continue in production longer under better conditions of management. Therefore, each person keeping poultry should become familiar with the causes of low production and endeavor to overcome them.

Good production during the summer and fall months adds materially to the income. This should be the season of greatest net profits. Eggs are advancing in price, and every additional dozen secured because of improved methods at this season means increased profits at the close of the poultry year.

Operations:

1. Handling the laying flock in the spring.
2. Feeding during the summer.
3. Using artificial illumination in the summer.
4. Keeping up the mineral supply.

5. Providing plenty of cool, clean water.
6. Keeping the flock vermin-free.
7. Keeping the laying quarters cool in summer.
8. Breaking up broody hens.

General information:

The broody condition.
Broody records.
Forcing the molt.

1. Handling the laying flock in the spring

When there are 13 to 14 hours of daylight, *artificial illumination* may be discontinued. In the northeastern section of the United States this is likely to be in April. Sufficient stimulation should then be received by daylight and sunlight until the days shorten in the fall.

In May or June many poultrymen move all or part of their laying hens to *barracks* quarters. This is a shelter where the hens may continue to lay for several weeks or months. When moved in May or June, egg production is not affected. Handle the hens carefully in order not to injure them. The purpose is to retain the hens so long as they continue to lay large, high-priced eggs while at the same time emptying the laying house pens for cleaning and housing the early-hatched pullets. These pullets will need to go into winter quarters probably in late June.

Barracks may be the permanent brooder house from which all chicks were removed in June, any range shelters not in use, sheds, or other convenient quarters which are available for a few summer months. It may be possible to combine pens without crowding, when, in large flocks, all hens cannot be moved to barracks. The empty pens may be cleaned and the pullets moved in from the range when ready.

The season of hatching may change the time when the laying quarters are needed by pullets, but not the time when it is desirable to move hens to barracks.

2. Feeding during the summer

To encourage higher food consumption, milk or water should be fed daily on the dry mash. Start this in May or June. A wet mash may be mixed or 1 quart of milk or water for each 100 birds may be spread over the dry mash in the feeders. Since the chickens usually prefer moist mash to the same kind of mash fed dry, it may be used in this way to induce them to consume more.

3. Using artificial illumination in the summer

When the amount of daylight and sunlight gets less, the bird receives less stimulation from those sources. At such times, or about August 15 to September 1, in the latitude of New York, artificial illumination should be given to the flock of old birds. (See page 164.)

4. Keeping up the mineral supply

Good poultry husbandry requires a plentiful supply of grit and oyster shell always before the birds. Place shell in several hoppers and grit in at least one. At the first sign of pickouts, give 1 tablespoonful of salt to each gallon of water for ½ day. Continue for 1 to 2 days.

5. Providing plenty of cool, clean water

In summer, fresh water is necessary for the cooling effect it has upon the body, as well as for supplying the necessary moisture demanded for egg production during heavy laying. A lack of a constant supply of water may be the principal cause of a drop in production.

6. Keeping the flock vermin-free

A flock of fowls may easily be thrown out of production during the summer months, if body lice or red mites gain a foothold.

Examine the perches and nests frequently for signs of

mites, and examine the birds for body lice. If they are found, take immediate steps to get rid of them. (See pages 252 to 254 for a discussion of the pests and methods of combating.)

7. Keeping the laying quarters cool in summer

One of the fundamental principles of poultry house construction is to build so as to avoid extremes of temperature. For good production, it is necessary to keep the interior of the houses cool during the summer.

An insulated roof or ceiling helps bring about these conditions. Insulated walls give still greater protection. Ventilate to permit warm air to escape quickly. (See page 86.) Sprinkling the litter and walls with water will produce evaporation and hence a drop in temperature. On very warm days sprinkling may be done several times.

Excessive heat during the day or night may cause a serious slump in egg production and sometimes death. The reason for this is clear when we consider the effect of heat on the birds. In an effort to keep their bodies cool, they spread their wings and stand with open mouths, panting. Because they cannot sweat, as do most other domestic animals, and hence are prevented from cooling their bodies through evaporation of moisture, their normally high temperature coupled with the heat of the house makes them decidedly uncomfortable. Practically the only way of cooling themselves is by rapid breathing. When the air they breathe is hot, the birds breathe faster in the effort to make themselves more comfortable. Much energy is lost in this way. Hence, food consumption is very low and the natural result is a drop in production. Hens do not eat as freely during hot weather.

8. Breaking up broody hens

Broodiness is a great handicap to production in some flocks. In certain varieties, a large number of birds are frequently broody at one time and remain so for a considerable period.

This means that many birds are out of production at all times during the summer. Unless hens are needed for hatching and to mother young chicks, they should be "broken up" as soon as possible.

During the summer an extra trip should be taken through the buildings each night, and any hens found on the nests should be confined in a broody coop. Supply these birds each day with plenty of water and mash. At feeding time in the evening of the third or fourth day they may be returned to the flock. The majority will be over their broodiness and will go on the roosts. Any hens that go back to the nest will be confined that evening and will remain another 3 or 4 days. (See pages 40 and 60 for plans of broody coops.)

GENERAL INFORMATION

The broody condition

Hens seldom go broody unless they have been laying. When confined immediately, they will often lay a few eggs in the broody coop. Supplying them with water and egg-making feed causes the egg yolks to resume their development and thus tends to keep the birds in laying condition, with the result that after a few days' confinement they may be released. They are likely to return to laying within 1 or 2 weeks. On the other hand, if a bird is left on the nest for several days her broody tendency increases and therefore a longer confinement is necessary. While on the nest, she goes without the necessary egg-making food and is partly nourished by absorbing the egg yolks. If a bird is opened after being broody a considerable time, the yolks are seen to have been practically re-absorbed. Therefore, when a hen has been broody for several days, more time is required to break up her broodiness and to redevelop egg yolks to the point where she will begin laying again. Under these conditions 3 weeks to 1 month, or longer, may be lost.

It frequently happens that food is kept from the broody birds with the expectation that they will get over their broodiness more quickly. The lack of food means more rapid absorption of yolks within the body and hence a longer time to regain a laying condition.

Broody records

Birds that become broody three and four times in one season are losing too much time to be profitable. As an aid in recording the number of times a hen is broody, the following plan may be used. Secure leg bands of a certain color or number, representing broodiness. (Spiral celluloid leg bands always of the same color are satisfactory.) Place one on the bird's shank each time she is found broody. In this way each hen carries her season's broody record with her. If a bird is found with two or three broody bands she may be viewed with suspicion. Examine her carefully by means of external characters (see Chapters I and II) to determine whether she should be kept or culled.

While it is true that high producers may go broody several times in a season, it is doubtful if the poultryman should breed from such a bird. The policy should be to breed broodiness out of the flock. (See page 3, Preparing to Cull, for relation of summer care of fowls to culling.)

Forcing the molt

Birds to be used the following season as layers or breeders should be made to molt and rest some time in the late fall (page 165). As seasons of highest prices for eggs may precede this period, some poultrymen "force-molt" their birds in early summer, expecting them to complete their molt and lay during the high-price season.

However, egg production during the summer, when prices are rising, is lost, culls are molted along with the high producers, and, therefore, held over when they should be marketed and the return over a full year period may not be increased.

Forced vs. Normal Molt *

	First group		Second group		Third group	
	Eggs	Gross income per year	Eggs	Gross income per year	Eggs	Gross income per year
Forced molt, June 1...	163 †	4.22	170	4.37	144	3.78
Forced molt, July 1...	171	4.44	198	5.11	111	2.87
Normal molt.........	179	4.65	215	5.49	169	4.33

* H. B. Hinds, "Molting and Housing Experiment," Bulletin 143, University of Arizona, Tucson, Arizona, 1933.

† From June 1 to October 1 of the following year (16 months).

These results show no gain financially in producing market eggs by early forced molting. The desirable practice appears to be one which attempts to hold birds in production until October or early November. (See page 164.)

COMMUNITY SURVEY

1. How many local poultrymen feed a moist mash in late summer to the laying flock?
2. How many use artificial lights in late summer to keep up production, and how are the lights used?
3. At what time of the year are they discontinued?
4. What system of management is used to provide laying house space when pullets are ready to be housed?
5. Are all hens sold at the end of their laying year?
6. Are some hens kept for breeders? What care do they have until eggs are needed for hatching?
7. Are some hens kept as second-year layers? Describe the care they receive until egg production starts again.
8. Are there any flocks that receive neither dry nor wet mash during the summer?

9. Compare the percentage production between flocks that receive mash and those that do not.
10. What provision is made to keep the houses cool in summer? To keep the birds vermin-free?
11. What plan is followed?

CHAPTER XXV

MID-SEASON CARE OF YOUNG STOCK

The growing pullets and a selected flock of growing cockerels are the pride of the poultryman's heart. In them is represented his future business. There is nothing that brings him a greater joy than to watch a flock of partly grown stock having healthy, smooth-feathered bodies and clean-cut, intelligent heads, and to realize that the dangers and uncertainties of rearing are largely past. To watch such a flock feeding or resting in the shade of a proper range, and to visualize the fine prospective egg producers and breeders he has labored for, is the delight of every true poultryman, and is an experience that he has earned a right to enjoy.

With proper rearing conditions, it is cheaper to grow stock than to buy it. Pullets of equal quality will ordinarily cost about one-third more than their rearing cost if purchased, and breeding cockerels will cost several times as much.

Operations:

1. Separating the sexes.
2. Using the catching crates.
3. Disposing of the surplus birds.
4. Selecting the range.
5. Supplying shade.
6. Locating the colony houses or shelters.
7. Feeding the young stock for healthy growth.
8. Providing ample ventilation.
9. Practicing eternal vigilance against lice, mites, and natural enemies.
10. Keeping the houses clean.

11. Guarding against theft and loss from predatory animals.
12. Educating the pullets in nesting habits.
13. Providing a cool, clean, constant water supply.

1. Separating the sexes

When sexed pullets are purchased the few cockerels found among them may be removed and used at will during the season. Straight-run chickens must be handled differently.

FIG. 284. Crates, with both ends removable, placed end to end at the exit. The birds are then driven into the crates.

Pullets develop better when by themselves.

Leghorns and other rapidly growing varieties develop sexually very early and the males soon become annoying to the pullets. For this reason, and also because they are taking up room, the cockerels should be removed from the flock when they are 3 to 6 weeks old. At this age the cockerels can easily be detected by their larger combs and wattles, red faces, and actions. Keep cockerels in separate pens and market as broilers, roasters, or capons, unless they are to be retained for further observation as breeding males.

In the heavier varieties sexual development is slower. The cockerels should be separated at 5 to 8 weeks of age.

If the chickens are brooded in large permanent quarters, they may be caught either for separating sexes or moving to

FIG. 285. Other crates are available and the pullets graded, cockerels removed, etc.

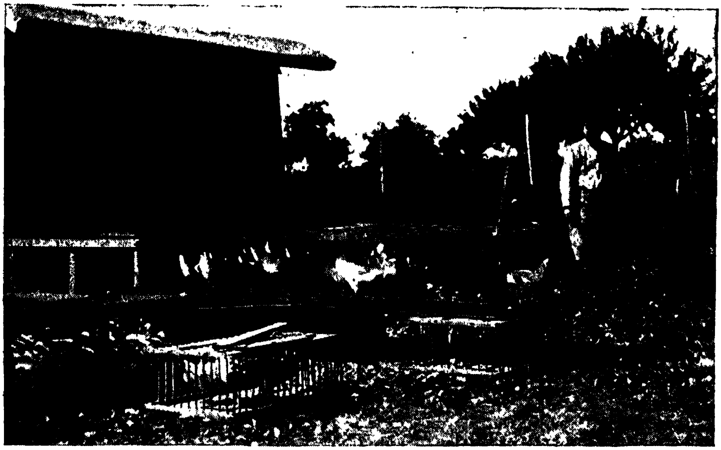


FIG. 286. Any remaining birds are allowed to run out, before the crates are again filled.

the range by penning in a corner 15 to 25 at a time using a wire screen (page 5) or a panel.

2. Using the catching crates

Catching crates may be used with any type of building. If the exit is not in a corner of the building, place a temporary partition to make a corner while driving the chickens out into the crates.

Keep the chicks confined the morning the flock is to be separated. Place a catching crate outside at the exit door. Open the door and let the chicks run out into the crate. When a sufficient number is in the crate, close both the exit and the crate doors. Use several crates end to end to simplify the work.

The chicks are now ready to be sorted. Remove both pullets and cockerels that are not developing properly, that show low vitality, are not properly feathered out, or otherwise do not measure up to a high flock standard of quality. Place the culls in other crates or carrying boxes and release the desirable pullets. Only a short time will be required for each house (Figs. 284, 285, 286).

Handle all birds carefully while doing this work. Serious injury is likely to result if chickens, especially pullets, are handled roughly.

3. Disposing of the surplus birds

The culled birds should be either sent to market at once or fattened. The cockerels which are to be retained for further observation and from which the future breeders are to be selected should be placed in a colony house on free range and fed for rapid growth, like the pullets, but on a separate range.

4. Selecting the range

A range should provide exercise, shelter, green feed, water, shade, sunshine, and safety (Figs. 287, 288).

FIG. 287. Well developed Rhode Island Red pullets reared under favorable environment.

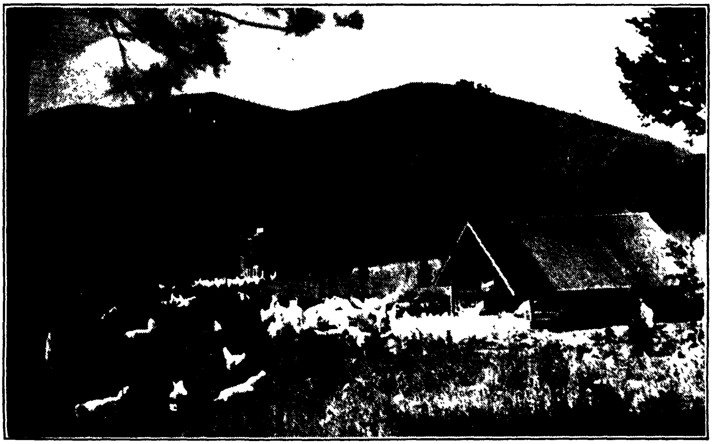


FIG. 288. The range on a New York State farm. There is opportunity for sunlight to reach the range. Ample shade and air drainage are evident.

5. Supplying shade

Some provision should be made for shade on every range where natural shade is lacking.

Place burlap, brush, or metal roofing on a frame supported by poles if it is necessary to provide shade artificially. Plant corn or sunflowers along the border of the range for shade.

6. Locating the colony houses or shelters

When the chicks are moved to the ranges, the colony houses or range shelters should be at least 100 feet apart. This will require about 1 acre for each four shelters with about 125 pullets to each shelter. A trip to the various shelters can be made in less time if they are arranged in a square rather than in a row. The nature of the range will determine the best arrangement. Moving the shelters about the range several times during the rearing season helps preserve the pasture.

Keep the chickens of different ages on separate ranges or on widely separated parts of the range until they are 2 or 3 months old. The best results cannot be secured where young chickens of different ages, extending over a period of several weeks' hatching, run together. This is particularly true during the early stages but applies throughout the rearing season. The older birds misuse the younger ones and eat their feed.

7. Feeding the young stock for healthy growth

See Chapter VI, pages 123, 125, 126, for ingredients, amounts, and method for determining growing rations.

A liberal supply of green feed for chicks of all ages is an indispensable factor in successful rearing. This factor should be taken care of with the proper range.

If chicks are fed as recommended above, there does not appear to be any valid reason why they should be fed yeast or any other commercial or proprietary remedy or so-called growth promoter.

TOTAL GRAIN AND MASH TO DATE *

Week	S.C.W. Leghorns	American Breeds	Week	S.C.W. Leghorns	American Breeds
1	14.9	11.2		Pullets only	1061.9
2	36.4	29.1	13	828.8	1190.1
3	65.4	57.5	14	937.0	Pullets only
4	102.9	97.7	15	1050.2	1320.4
5	153.0	155.4	16	1166.2	1457.3
6	210.4	228.1	17	1281.3	1605.6
	Pullets only		18	1399.3	1738.6
7	282.3	313.0	19	1503.2	1807.5
8	346.8	413.3	20	1612.4	1998.5
9	446.2	530.0	21	1740.3	2144.8
10	527.6	647.4	22	1855.5	2286.9
11	612.5	782.2	23	1980.2	2442.2
12	719.5	922.3	24	2106.8	2589.1

"Weight Changes in Chickens," Bulletin 24, Cornell University.

* Average weekly food consumption, in pounds per 100 birds. Mash only until 8 weeks of age.

Outdoor hoppers (Figs. 292, 293, 294), having compartments for grain and mash, should be placed near each house and a hopper of grit provided.

Grain may be hand-fed if desired, on clean soil in dry weather, but hopper-feeding is more sanitary.

Pullets should always go into laying quarters well developed and fat.

8. Providing ample ventilation

All that is needed after the brooding days and during the summer is a shelter that will protect the chickens from the heat and storms.

It is scarcely possible to overemphasize the need for an abundance of fresh air, day and night. Developing pullets should never be compelled to pass the hot summer nights in an

FIG. 289. Open-air shelters. Note ideal conditions of shelter, coolness, and opportunity for wide range.

FIG. 290. A cheap, serviceable range shelter. Sides are of wire. Four sheets of $2' \times 10'$ metal roofing cover the $8' \times 8'$ shelter. Two men can easily carry it to a new location.

FIG. 291. Leave the pullets on range until they commence to lay. Do not attempt to retard production. Hopper-feeding grain and mash promotes desirable growth without premature production.

overcrowded and poorly ventilated house. Such treatment prevents normal growth and development, and may be the chief contributory cause of disease.

It is hardly possible to get too much air movement during

FIG. 292. A desirable range feeder, easily constructed, 6′ long and 9″ to 15″ wide.

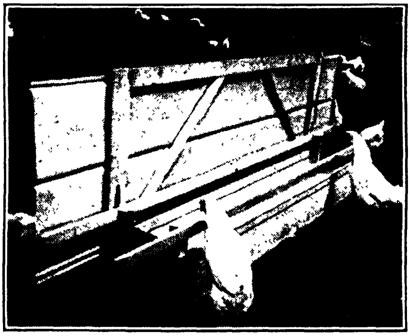


FIG. 293. Same feeder as shown in Fig. 292. Note metal roof 2′ × 8′, open to permit filling or cleaning, 1″ × 2″ × 8′ handles, and space below handles for the birds to feed. The sides are 8″ high. Corner posts are 2″ × 2″, and 2″ × 2″ pieces are nailed to the bottom to raise the feeder box from the ground and to support the standing board.

summer in a colony house. During summer and after the chicks are through with artificial heat, remove all windows. Open both front and rear ventilators. Leave the windows and ventilators open until the pullets are moved to their permanent quarters early in the fall.

If possible, place the house where it will be in the shade during the middle of the day. Face the house so that the front

will be best sheltered from the wind and rain. In many locations, this will mean that the house should face toward the east. This will also make the house cooler than if it faced south.

Frequently the most natural, safest, and most satisfactory

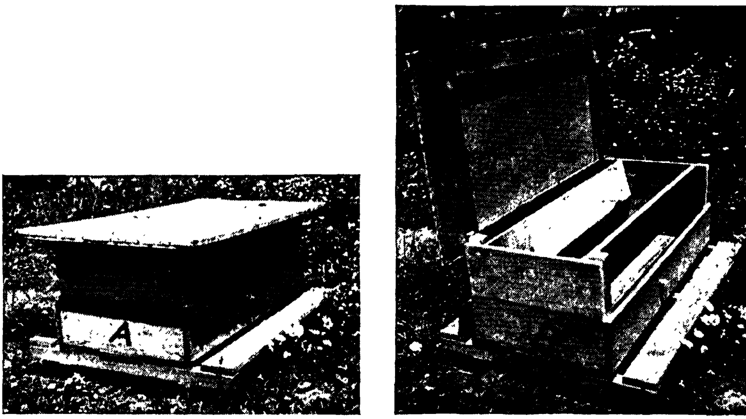


Fig. 294. Range feeder. This feeder is sanitary, compact, light, and efficient. The top is flat, which makes it convenient to carry to and from the range and for storing away. The top is made of 6″ and 3″ boards, as shown in *B,* and covered with galvanized sheeting. The feeder box is 18″ wide and 4′ long overall. A ½″ × ½″ lip helps prevent wasting. The sloping sides extend about 1″ below the top level of the side boards, are 6″ wide, 9″ apart at the bottom, and 11″ at the top. Side boards 6″ wide. Two 2″ × 2″ skids run lengthwise. A lath placed 1″ to 2″ above the side board prevents the chicks from standing on the sides.

place for pullets or cockerels to rest during the day and roost at night, until the time when they are placed in winter quarters, is in the trees of an orchard. Provided the trees are trimmed low in order to catch the pullets more easily when housed, the shelters may be placed among them for this purpose.

9. Practicing eternal vigilance against lice, mites, and natural enemies.

(See pages 252, 254, 467.)

10. Keeping the houses clean

Sand, shavings, or straw make fine colony-house floor covering. Range shelters should be moved several times during the growing season, or have wire floors, to keep the pullets from the droppings.

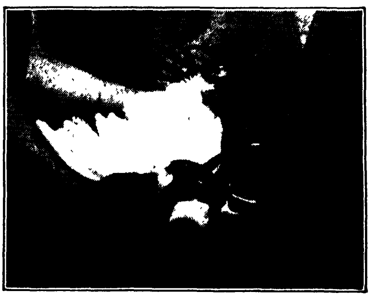


FIG. 295. The tattoo marks are left on the web of the wing by the marker. Tattooing may be done at the time range birds are vaccinated for chicken pox, or at any other convenient time.

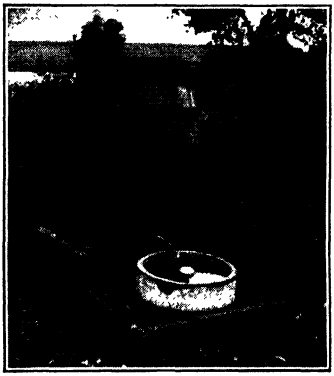
FIG. 296. A nest similar to the laying-house type located on the range shelter or colony house serves to train pullets and lessens their confusion when housed.

11. Guarding against theft and loss from predatory animals

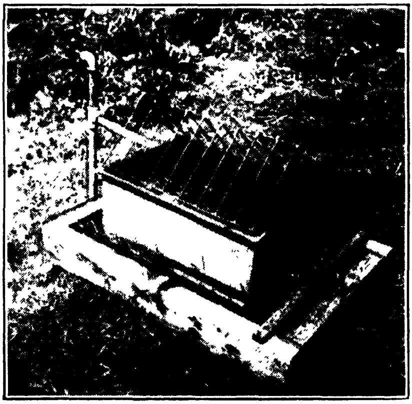
In many localities the danger of losing chickens by theft is great. Where stealing is likely to occur, it is a wise investment in time and money to safeguard the year's crop of pullets and cockerels, a crop which it would be practically impossible to replace in kind and quality.

A 58-inch standard horizontal wire fence fastened to the inside of the posts and an *electric charged wire* on insulators on the outside 3 inches away from the fence and about 5 inches aboveground is an aid in preventing trouble from foxes. The grass must be kept mowed under and around this wire to prevent grass contact with the charged wire.

FIG. 297. Device for holding metal nests on the range if pullets are not housed before laying commences. Here pullets are caught in the nest and transferred to crates. Each day's catch is placed in the laying house. This system avoids catching pullets out of trees at night, and it automatically leaves the slower-maturing birds on the range.



A.



B.

FIG. 298. Types of range waterers. *A*. Barrel-supply feeding by float valve into a concrete receptacle. *B*. Water piped to the range and supplied by an automatic float.

A good watch dog, either chained to a kennel or at large, is likely to be a profitable investment.

Electric alarms, either opened or closed circuits, connecting the rearing houses with the caretaker's room have proved desirable.

Tattooing the web of the wing with an identification number, recorded with the state police and sheriffs, is effective. Such organized tattooing plans are in use in many states. Consult your state poultry husbandry department, or the state police.

When it is generally known throughout the neighborhood that the above special precautions against stealing have been taken, that fact, in itself, is the best insurance that would-be chicken thieves will consider it safer to steal elsewhere.

12. Educating the pullets in nesting habits

To avoid the later difficulties of floor eggs, egg breakage, egg-eating habits, and cannibalism, train pullets while on range by providing suitable nesting places for any early layers (Fig. 296).

13. Providing a cool, clean, constant water supply

Natural or piped running water is best (Fig. 300). Other methods are a water pan and float on wire-covered floor, or a water barrel with faucet set to drip or used as a supply to fill shaded pans.

COMMUNITY SURVEY

1. What is the largest number of pullets grown on a single local farm?
2. How many chicks were required for each pullet reared to laying age?
3. What percentage of the chicks at start were males?
4. What provision is made for summer range?
5. Describe the type of range house used.
6. What method is employed for keeping the rearing houses cool and well ventilated at night during the summer?
7. Do the pullets roost in trees?

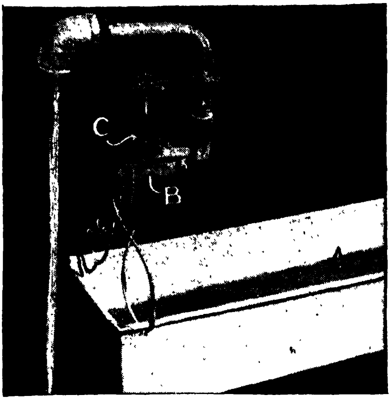


Fig. 299. A constant supply of water may be assured by an automatic valve. As the water in the trough *A* is used, the weight on the arm *B* lessens and the spring *C* pulls the arm up, thus letting water flow into the trough. Manufactured by White Manufacturing Co., Gardena, Cal.

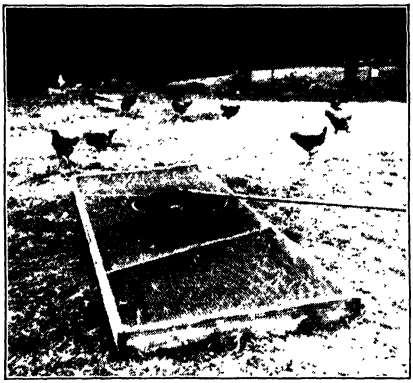


Fig. 300. Running water piped to this tub, placed on wire over a hole, provides clean dry surroundings for the range.

8. If so, how are the pullets caught when placed in the laying houses in the fall?
9. Describe the rearing ration and method of feeding used by local poultrymen.
10. At what age are the cockerels separated from the flock?
11. How many poultrymen transfer to "Bachelors' Hall" cockerels that are to be used as future breeders?
12. What is the basis upon which these cockerels are selected?
13. Are the young birds culled during the rearing season?
14. What points are regarded as desirable? As undesirable?
15. Inquire if poultrymen have experienced any losses from chicken stealing.
16. If stealing has occurred, were the thieves apprehended, and how?

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ROEHL, L. M., and ANDREWS, F. E., "Cornell Outdoor Poultry Feeder," Cornell University Extension Bulletin 373, 1937.

CHAPTER XXVI

FITTING, EXHIBITING, AND JUDGING POULTRY

Operations:

1. Selecting birds for exhibition.
2. Preparing birds for the show.
3. Judging poultry.
4. Conducting a poultry show.
5. Conducting an egg show.
6. Baby-chick shows.

1. Selecting birds for exhibition

The selection of birds for exhibition differs from ordinary selection in the fact that the poultryman is choosing from the best of his birds, after their number has been greatly reduced by a most rigid process of elimination. The equipment which it is advisable to secure includes the following articles:

(*a*) A portable wire enclosure for rounding up the birds in the houses or on range, where they can be observed, caught, and handled with the least possible disturbance because of fright.

(*b*) A long catching hook of wire with short wood handle.

(*c*) A catching net.

(*d*) Two or three catching and carrying crates.

(*e*) A book in which to write the numbers of the birds handled and the descriptions of their more important characteristics.

2. Preparing birds for the show

To show to the best advantage, birds must be clean. Occasionally pullets and cockerels reared on free range can be

placed on exhibition in perfectly satisfactory condition, so far as cleanness is concerned, without washing. With most young and old stock, however, a thorough cleansing of the plumage will make so much improvement in their appearance that it will pay well to wash the birds before exhibiting them.

Material for Washing Birds for Exhibition

Three ordinary washtubs
Ivory soap
Sponge
Scrub brush
A room heated to approximately 90 degrees F.
Clean, soft water

Arrange three tubs containing clean, soft water on a bench at convenient height. The temperature of the water in tub No. 1 should be about 90 degrees, in No. 2 lukewarm, and in No. 3 ordinary air temperature. Dissolve one cake of ivory soap in tub No. 1, and form suds. Submerge the bird completely, except the head. Sponge the plumage thoroughly and make certain that all the dirt has been removed, clear to the skin, by squeezing gently, but not rubbing, with the hands. With the scrub brush, remove all dirt and old scales from the shanks and feet. When the bird is thoroughly cleaned, transfer it to tub No. 2, submerging and withdrawing, permitting the water to remove all the suds from the plumage. Then dip the bird in tub No. 3 for an additional rinsing and to accustom it to the cooler temperature of the room.

The use of bluing in the water is not necessary on pure white birds and is not justifiable on any others.

Provide clean litter in clean coops in which to place the birds while drying. Do not place them in a draft.

Place the birds in a partly darkened room until nearly dry; then give more light, so they will dress their plumage.

Provide a temperature not lower than 70 degrees or higher than 90 degrees. A lower temperature would be uncomfortable for the birds, because of rapid evaporation of moisture,

and a higher temperature would be likely to dry the plumage too quickly and leave it in a crumpled condition. The birds can be depended upon to put their plumage in proper order during the drying process.[1]

A. Training birds for exhibition. Provide a room containing coops similar to those in which the birds are to be exhibited. There the birds may become coop-wise and may be further observed before being shipped to the show.

The most intelligent birds are likely to be the best ones for exhibition. Such birds will usually respond quickly to training. They should be taught to be friendly and not to be easily frightened, in order to show to best advantage their type, carriage, and action.

With the aid of a short rod, a bird can be trained to move about the coop without fright and to feel perfectly at home when viewed by the judge and spectators. If this preliminary training is not provided, very valuable birds frequently are so timid when on exhibition at the show that they do not appear to advantage. For example, they may carry the tail so erect or so far to one side as to be seriously handicapped in competition with birds that feel at home when on exhibition and therefore show their true quality to the best advantage.

B. Shipping birds for exhibition. (1) Provide shipping coops which will carry the birds to the show and back with the

[1] The authors purposely omit any instructions for preparing birds for exhibition which involve operations for removing evidence of minor defects and disqualifications, on the ground that the publication of such knowledge of questionable practices will tend to encourage, rather than to discourage, faking in poultry shows. Faults in birds should be bred out, and not pulled out or artificially covered up or removed. Birds should be shown in their natural color and conditions, with the exception of the removal of dirt. The bleaching of plumage, the removal of off-color feathers, the mutilation of the comb, and other operations intended to deceive the public and the judge into believing that a bird is what it is not, have worked incalculable injury to the reputation of poultry shows and exhibitors in the minds of the public.

least possible danger of injury, due to fighting or rough handling in transit or exposure to variations in temperature.

(2) Place in the bottom of each shipping coop at least 2 inches of clean shavings or straw, as an absorbent, to assist in keeping the birds clean and comfortable.

(3) See that each coop has a non-breakable receptacle, to carry water in the case of long-distance shipments or soaked

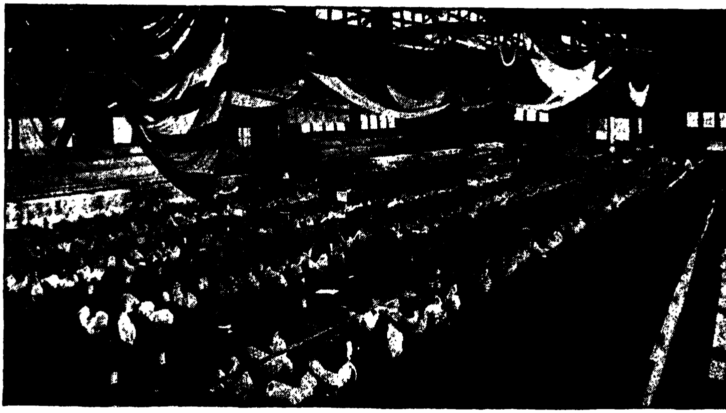

FIG. 301. A production poultry show. Note ample space for judging and observation.

grain for near-by shipments. Also add green food, such as cabbage or beets.

(4) Provide shipping tags showing the name and address of the exhibitor, or the farm, or both, the leg-band numbers of the bird or birds in the coop, the shipping directions for the return of the birds, and the name and address of the show to which they are to be shipped.

The tag should be attached to the shipping coop, in duplicate, on each side of the coop, by wiring or tacking in such a manner as best to safeguard it against injury or loss in transit or from being destroyed by the birds in the coop.

(5) Place leg bands, preferably of the sealed type, on each

bird, in order that any bird may be identified in case of loss in transit, or transfer, by mistake or otherwise, at the show.

3. Judging poultry

The following articles are needed by the judge:

(*a*) A suitable garment, such as a linen duster.

(*b*) A short rod for moving the birds about in the coop.

(*c*) A pencil and eraser.

(*d*) A pad on which to record the characteristics of the birds.

JUDGE'S DESCRIPTIVE RECORD OF DEFECTS

Exhibitor's number....................................
Coop number..
Band number..
Number of birds in Class..............................

1. *Standard Disqualifications*
2. *Condition*.................................. { Natural vitality / Disease / Vermin / Cleanliness }
3. *Handling quality.*
4. *Head.*
5. *Body.*
6. *Legs and Toes.*
7. *Molt.*
8. *Plumage.*
9. *Pigmentation.*

Judge........................

The judge should be assisted by another person, whose duty it is to act as secretary in taking down the comments of the judge, to locate the birds in the class, and to make a record of the awards.

A. Method of judging. When exhibitors or visitors are particularly interested in the judging, the judge may make the occasion an educational demonstration.

To do this, make all observations on the quality of the birds

in an audible tone, so that all who are present will have the opportunity of seeing the birds handled and hearing the opinion of the judge as to the merits and demerits of each bird handled.

When birds showing outstanding quality or lack of quality are being judged, give the exhibitors and visitors present an opportunity to handle them, if time permits and the owner has no objections.

B. Steps in judging. (1) If exhibitors and visitors are present make a public announcement of the policy to be followed in judging birds, and request those present not to give information at any time which would enable the judge to know the owner of any of the birds.

(2) Make a rapid examination of all the birds in all the classes which you are to judge, in order to get a proper estimate of the size of the job and the general quality of the stock.

(3) Make a careful inspection of all the birds in the first class to be judged, without removing the birds from the coops. This examination ordinarily will enable the judge to eliminate a number of birds which show by their appearance that they are not worthy of individual handling. This saves time, and is fair to the exhibitor if it is understood that the judge will be glad to examine any particular bird, if requested to do so.

(4) In removing birds from the coop, endeavor to avoid frightening the bird. This can be best accomplished either by seizing the bird by the shoulder or running the hand under the body and drawing it forward through the door. Place the other hand on the back of the fowl if it should be necessary to do so. When judging, hold the bird in a comfortable position. (See Chapter I.)

(5) Commence at one end of the line and handle each bird, calling attention to its outstanding qualities, desirable and undesirable. Designate, by reversing the exhibitor's card, the coops containing birds that are not worthy of further consideration.

(6) Make a careful re-examination of each of the birds remaining in the class, reducing them "to lower terms" by turning over the exhibitor's card as before.

(7) In a close competition, it aids greatly in forming correct judgment to remove the remaining birds to adjoining vacant coops. This method of placing the final award has the greatest educational value to the exhibitors present and other observers, since it enables the judge to make fine distinctions between birds presumably of very similar quality. It furnishes the most intense interest in the judging process.

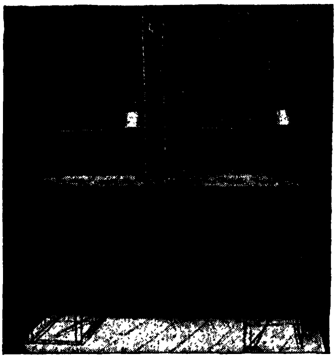

FIG. 302. A desirable exhibition coop. The section shown consists of two compartments separated from each other by a 2″ space to prevent fighting. The wire coops set on a wooden bottom supported by wire standards or wooden horses.

When the judge's decision is rendered in each class, his secretary should enter in the judge's book the proper award. The book should be inspected by the judge and signed by him when the judging has been completed.

(8) After all the classes have been judged, it is advisable for the judge to remain for informal discussion with exhibitors.

4. Conducting a poultry show

Secure, if possible, a room which is properly lighted and wide enough to permit the placing of at least four rows of coops, one row against each of the side walls, and two rows back to back in the center, leaving passageways for visitors on either side, with opportunity to pass around the center rows at either end. The room should provide a reasonably uniform temperature of 60 to 70 degrees F. and should permit proper

ventilation to make the place congenial and safe for the poultry and persons in attendance.

Suitable coops usually can be rented, provided the funds are not available for their purchase or manufacture. One of the most satisfactory types of coops is shown in Figs. 302, 303. This prevents fighting between birds in adjoining coops, gives an unobstructed view of the birds in all directions, can be knocked down for shipment, is strong and durable, is convenient for feeding, watering, and handling the birds, and is

FIG. 303. The coop knocked down for storage or shipment.

easily cleaned and disinfected. These principles should be incorporated, in so far as possible, in the making of coops for temporary use. A proper arrangement of boxes and poultry netting can be made to serve the purpose temporarily at comparatively low cost.

Collapsible wooden horses may be used to support the coops at the proper height to permit the easy observation of the birds. The bottom of the coop should be approximately 30 inches from the floor. Each coop should be provided with cups for feed and water and should be properly littered with dry, clean shavings or sawdust.

An entry book is necessary for recording each exhibitor's name, number, and address, and the leg-band number of the birds in each entry (Fig. 305).

There should be a judge's book showing the entry numbers and coop numbers in each class (Fig. 304).

Cards made out in duplicate should be provided, giving the entry and exhibition coop number, one to be attached to the

shipping coop when the birds are removed, and the other to be attached to the exhibition coop when the birds are placed in it. This facilitates the accurate receiving, placing, and returning of the birds.

Second New York State Production Poultry Show, 1923

Cockerels (A) Uncertified Without Trapnest Records.

Exhibitor No.	Coop No.	VARIETY	Class No.	Band No.	AWARDS 1st	2d	3d	4th	5th	REMARKS
20	46	S.C.W.L	3	29						
20	47	"	3	30						
20	48	"	3	31						
20	49	"	3	32						
20	50	"	3	33						
27	51	"	3	34						
42	52	"	3	35						
42	53	"	3	36						
44	54	"	3	37						
44	55	"	3	38						
57	56	"	3	39						
57	57	"	3	40						
57	58	"	3	41						
60	59	"	3	42						
60	60	"	3	43						
60	61A	Buff L. S. C.	3	409						

FIG. 304. Sheet from judge's book.

As far as possible, all birds competing in the same class should be staged together. This simplifies judging and increases interest in the show.

GENERAL INFORMATION

(1) The names of the exhibitors should not be allowed to appear on the exhibition coop until after the awards have been made and the prize cards placed.

(2) The decision of the judge should be final.

(3) Visitors should not be allowed to open coops or handle

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CHAPTER XXVIII

SHALL I BE A POULTRYMAN?

The choice of an occupation is one of the most important decisions that we are ever called upon to make. In considering the poultry business, one should carefully weigh the main factors upon which success in this field depends.

General information:

1. The personal inventory.
2. The labor problem.
3. The necessary cash and credit.
4. Limitations of the business.
5. Special advantages of the business.
6. Methods of getting started in the business.

1. The personal inventory

In choosing an occupation one should first consider the personal characteristics necessary for success. Some persons might succeed very well in a city occupation and yet fail in a farming occupation like poultry raising. A successful poultryman must have two types of characteristics: (*a*) natural and (*b*) acquired.

Chief among the natural characteristics are love of the business, initiative and ability to work, and good judgment. One must like poultry in order to succeed, for the birds are very susceptible to the feelings of the person caring for them. No longer may one handle poultry by rule-of-thumb methods. As in other productive occupations, one must be willing to work and have the physical ability to work skillfully. Initiative in the poultry business is especially important, since the poultry-

man must constantly observe the birds, watch his accounts, and otherwise study his business, being ready at all times to plan new improvements. As poultry respond to the feelings of their keeper, so the person in charge must be quick to understand the birds. Such "chicken sense" constitutes good judgment in caring for and managing the flock.

The chief acquired characteristics are knowledge and skill in conducting the business. These abilities can be acquired only through training and experience. The young man who is anxious to enter the poultry business will find that time and effort spent in acquiring training in poultry farming constitute an excellent investment. To be able to perform the work skillfully, a man must have experience. If he can get this experience with the help of an instructor or a successful poultryman, he will be saved many expensive mistakes. Another very necessary qualification is a knowledge of the business methods commonly practiced. The poultryman must know how to deal with people, how to be courteous, prompt, tactful, and at all times he must be honest and ambitious to build a reputation for himself.

Poultry farming is not an easy business. It is, however, a worthwhile occupation. It requires an alert, keen mind and a willingness to work hard with mind and body.

2. The labor problem

Securing and keeping competent help are the most difficult problems for the poultryman to solve. On a small plant, the operator can do the feeding, selecting, and other work requiring judgment, carefulness, fidelity, and a love for the work, and may employ help for doing the rough work. On larger plants, the operator finds that he cannot do all the important work himself and that he must employ men competent to perform skilled work for him. Herein is a serious difficulty, because there are comparatively few persons who have received special training or who are experienced in handling birds. Persons so trained or experienced are able to command wages so high

that it is difficult for the operator to meet them. Also, skilled laborers are constantly seeking an opportunity to go in business for themselves. Many persons who are financially "well to do" operate poultry plants as a "hobby" and offer attractive wages to poultrymen. This practice tends to keep the wages of skilled workers quite high.

3. The necessary cash and credit

As in most productive enterprises, the poultryman needs both cash and credit. The amount of each required will be determined by the method of starting in the business, the size of the enterprise, the efficiency of the plant, and the financial standing of the operator in the neighborhood.

If a place is rented, less ready cash will be needed than if a plant were purchased, unless many new buildings or much equipment is necessary. Credit for the poultry enterprise is often impaired by the lack of public confidence in the poultry business. This is a serious handicap. Without doubt, the lack of confidence is due to the large number of persons without experience who have entered the business and failed.

A sound method of starting a poultry business is to begin with a small plant and build up gradually. One should determine in advance the amount of cash and credit needed and the amount which he has available. For the beginner, it is well to reserve approximately one-half of the funds for working capital, leaving the remainder as fixed capital invested in land, buildings, and equipment. The business may be enlarged as the net earnings increase.

4. Limitations of the business

Many years of practice and observation have shown that there are several conditions which serve to limit or handicap the poultryman. One should be familiar with these in order to profit by the experience and study of others. These limiting factors are:

(1) Small size of the individual fowl.
(2) Short life of the individual fowl.
(3) Small value per individual unit.
(4) Problems in controlling egg production.
(5) Difficulty in controlling fertility and hatchability.
(6) Dangers from diseases and parasites.
(7) Dangers from stealing.
(8) Dangers from fire.
(9) Difficulties in marketing.

The small size of the fowl, together with the large number of birds in the flock, make it very easy to lose sight of the individual. Disease may progress unobserved more easily than with larger animals. Thus, risks and losses are greater. Individuals may disappear from a flock, especially in large flocks, and the loss may not be discovered until the fowls are counted. The feed requirements of individual birds vary, but it is impossible to feed every individual separately as is done with cattle. This problem of feeding requires special ability in the poultryman. (See Chapter V.)

Because of the short normal life of the fowl, there is rapid depreciation of stock, which requires frequent renewal. Poultrymen must, therefore, take the risk from year to year in hazards of brooding and rearing and sometimes incubation.

Egg production cannot be absolutely controlled, since it is a reproductive process, but great strides have been made in this direction. Artificial illumination, flock segregation, and improvements in hatching, feeding, and housing are at present the best-known aids in the control of egg production. The proper use of these, coupled with correct breeding, secures good production and quite satisfactory hatches throughout the year.

The fertility and hatchability of eggs and the strength of the young stock depend on the vitality of the breeding flock and feeding and mating methods. Severe climatic conditions or wrong handling prior to or during the breeding season give unsatisfactory results.

Both young and old stock are susceptible to diseases and parasites because of their small size and the mass method of management practiced. The young are naturally delicate and fall easy prey to predatory animals and diseases. Mature stock resist many diseases but are easily thrown out of condition by mismanagement, which renders them susceptible to various troubles. New forms of diseases are constantly preying upon the flock. *Diseases and parasites are stimulated by man's mistakes in methods of care and management.*

Many poultrymen are handicapped by thieves. There is a popular idea that the "chicken thief" is not a serious malefactor. When we consider that the loss of mature individuals represents an entire season's work and money, we begin to realize the seriousness of this crime. Poultrymen may also sustain large losses by fire. The use of incubators and brooders increases the fire hazard. The risk is small, but fire occasionally occurs.

The vast number of eggs which must be graded as to color, size, and shape, and the loss from breakage and inferior interior quality constitute vital problems in marketing. To succeed, the poultryman must understand both production and marketing problems. Unless one can market successfully, it is of little avail to produce.

5. Special advantages of the business

The following constitute the more important advantages of the poultry business:

(1) The money value of poultry and eggs as human food.
(2) The efficiency of poultry in multiplying and producing human food.
(3) The maintenance of soil fertility.
(4) Attractiveness as a business and homemaking occupation.
(5) Adaptability to many persons and types of farming.

(6) Superior marketing advantages.
(7) Available knowledge as a basis for successful methods.

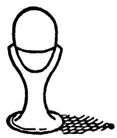
The egg is the most universally used of any animal product except milk. It is a staple commodity for which there is no substitute. The egg is essentially liquid meat, being one of the most easily digested and assimilated forms of animal food; it also is one of the richest in growth-promoting vitamins (Fig. 322).

The quick growth of the fowl, its early laying maturity, heavy laying, and natural vitality to resist disease offset the handicaps of short life, small size, and the low money value per individual. The birds' self-reliance and flocking instincts make it possible for large flocks to be brooded, housed, and fed together, and also make possible large poultry enterprises. The fact that poultry are natural foragers enables farm flocks to get much of their living from food which otherwise would be wasted. Furthermore, the addition of poultry manure and litter to the soil constitutes an excellent method of improving fertility, since these materials contain considerable quantities of nitrogen, phosphorus, potash, lime, and humus.

From the standpoint of the attractiveness of the poultry business, it is to be noted that relatively small amounts of capital and land are required and that there is a quick turnover of capital. Also, with good care and management, the business may be made reasonably profitable. Like other farming occupations, it is a healthful vocation.

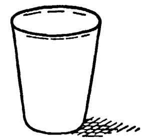
In considering adaptability to persons and types of farming, it is significant that poultry is found on 85 per cent of the farms of this country. Without doubt, poultry is kept in conjunction with other types of farming more than any other kind of livestock. This is because poultry provides the table with eggs and meat and furnishes an income throughout the year. Domestic fowls suffer less under close confinement than other kinds of animals, and therefore may be kept on small village lots. Because poultry keeping does not require as

EGGS AND MILK



AN EGG

Weight–2 Ounces (56 Grams)



A GLASS OF MILK

Weight–8.5 Ounces (240 Grams)

% COMPOSITION:

Water	73.7%
Fat	10.5%
Protein	14.8%
Mineral Matter	1.0%

% COMPOSITION:

Water	87.0%
Fat	4.0%
Protein (Casein & Albumin)	3.3%
Carbohydrates (Milk Sugar)	5.0%
Mineral Matter	0.7%

AMOUNT PER UNIT

One Egg, One Glass of Milk—Grams

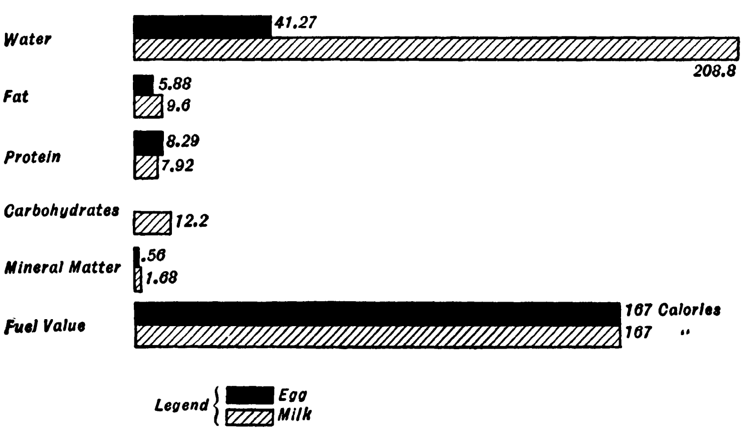


FIG. 322. Eggs are one of our most valuable food products.

heavy manual labor as most other kinds of farming, this enterprise serves to interest many women and children on farms and in villages.

All kinds of poultry are efficient transformers of raw materials into high-priced finished products. The domestic fowl, for example, transforms about 90 to 100 pounds of grain and mash, ¾ pound of oyster shell and grit, and 50 gallons of water into approximately 25 pounds of eggs yearly, besides maintaining the body. It is a great advantage to many persons to be able to ship concentrated commodities to market. This the poultryman is able to do.

Because eggs may be held under favorable conditions without cold storage for several days, it is not usually necessary to ship to market more than once or twice a week. Also, poultry may be held, killed, and shipped as the market requires. This is an advantage as compared with the production of highly perishable products, which must be shipped daily.

The egg is sold in its original package, the flavor and odor being concealed. The shell container prevents the quality from being known to many consumers until the egg is used, thus placing a premium on superior-quality products. Producers who have established a reputation for high-quality eggs frequently receive several cents per dozen over the highest market quotations. The fact that eggs and poultry may be preserved in storage for many weeks exercises a stabilizing influence upon prices. While the storage eggs and poultry are not equal to the fresh product, as is true of practically all preserved or storage food products, consumers are provided a year-round supply at much lower prices than would be possible without storage, and the producer is accorded a higher seasonal price.

6. Methods of getting started in the business

"What is the best way for me to start?" is a most natural question for a person desiring to enter the poultry business. The answer depends upon the individual, and upon his available cash, experience, and special opportunities at the time.

Education, experience, and capital usually present the most difficult problems for the beginner.

The following are the six usual methods of entering the poultry business. The amount of cash and experience necessary increases in the order named: (1) working for salary for owner or operator; (2) working for salary with percentage of the profits; (3) share rent; (4) cash rent; (5) partnership; (6) buying outright.

Salary. This method is usually employed when one desires to accumulate money or experience to start for himself. If the plant is up to date, this constitutes an excellent opportunity for the employee to learn while the employer assumes the risks. One is likely to learn in direct proportion to the extent to which he does all kinds of work and studies the business. This method permits the beginner to gain in maturity and judgment before making a permanent investment for himself.

Salary with percentage of profits. This method is most advantageous when one is in charge of production and selling, since such an arrangement is satisfactory to both employer and workman. The salary acts as insurance for the laborer, and sharing in the percentage profits induces him to work for high yield and good prices, which, of course, the employer is anxious to have. A bonus on the number of chicks reared or of eggs produced frequently is a satisfactory plan.

Share rent. Share rent is higher than cash rent. The landlord assumes the risk of a poor tenant. If he owns a part of the stock, the risk is considerable. Share rent is common because it requires less capital on the part of the tenant. The landlord provides the land, buildings, equipment, and perhaps stock. Part of the running expenses, such as feed, are paid jointly. If both desire to participate jointly in expenses and receipts, a partnership is preferable.

Cash rent. This is desirable if the tenant knows his business, and can produce successfully and market efficiently. The tenant assumes the risk of failure. The better the prospect is for making profit, the greater is the advantage to the cash

FIG. 323. A modern poultry farm layout. Note spacious laying house, permanent brooder, and ample rearing range.

renter. The simplest procedure in determining a fair rent is to inventory the buildings, equipment, and stock that are provided by the landlord. The rent should be at least 5 per cent of this investment and should also cover taxes, insurance, and depreciation, which the landlord usually assumes. (For inventory values, see page 184.) It is better for the tenant to buy all stock. When the landlord provides part of the stock, the rent is higher because of the increased risk. A long lease of 3 to 5 years is better for both landlord and tenant.

Partnership. This is the fairest form of a share lease. Dean W. I. Myers, of Cornell University, suggests that "the general plan of such a lease might be that all going expenses of the poultry enterprise and of maintaining the buildings should be paid out of receipts. After this a stipulated salary should be paid the tenant for his work, and then interest should be paid the landlord on his investment. Anything remaining above these items should be divided equally. Such an agreement has the advantage of taking the guesswork out of the lease, since all receipts and costs would be shared equally by both parties.

Many dangerous complications may develop in poultry-farming partnerships, owing primarily to the fact that home as well as business relations are involved. All partnership agreements should be in writing.

Buying outright. This is the ideal method for those who have sufficient education, experience, and capital to justify it. Risk is assumed entirely by the owner, and changes in the plant and management may be made at his discretion. The beneficial effect of the pride of ownership is one of the most important elements in this method. One usually takes most interest and pride in the effects of his own handiwork.

COMMUNITY SURVEY

1. Ask one or more poultrymen, who started with a small business in your neighborhood, to give you the following details:

(*a*) When they started with poultry.
(*b*) What problems appear to give the greatest difficulty in establishing and building up a poultry plant and business.
(*c*) How the labor problem has been handled.
(*d*) Whether or not it has been difficult to secure and keep competent labor.
(*e*) Which one of the several ways of starting in poultry work these poultrymen would recommend.
(*f*) What troubles they have experienced with the stock, and how they have learned to combat and prevent these troubles.

Directions for a Study of the Location and Layout of a Poultry Plant

Farmers who make poultry raising their major enterprise find that special buildings, equipment, and layout are needed in order to make the business profitable. For students or farmers who contemplate taking up a specialized type of poultry farming, there is no better means of preparation than to study the practices of successful men in the region. Several hours spent in studying their plants and interviewing them will yield valuable returns to the student. He may profit by their successes and failures. In most communities, there are one or more farmers who are practicing poultry farming on an extensive scale. Visit several of these farms and ask for an interview with the operator. Equip yourself with notebook and pencil, observe the following points, and secure the suggested information from the farmers.

Observations on the plant:

1. Sketch the layout of the plant.
2. Note the location of the following buildings:

   Laying and breeding houses.
   Brooder houses.
   Range shelters.
   Bachelors' hall.
   Hospital, crematory or disposal pit.
   Barracks shelters.
   Service building.
   Incubator building.
   Manure shed.
   Storage building.

3. Are the buildings conveniently located?
4. Are the buildings located so as to conserve the time and effort of the operator?

5. What system of housing is used?
   (*a*) Colony system?
   (*b*) Continuous single story house system?
   (*c*) Multiple-story.
6. How much range is allowed for young stock?
7. What is the character of the range for growing stock?
8. What system of fencing is used?
9. Is the range cultivated?
10. Does the range provide shade and green growth. What is its soil type? Are specially prepared pastures provided?
    (*a*) What seed mixtures are used?
    (*b*) What care is given the pasture during the growing season?
11. In what directions do the buildings face?
12. Are the buildings protected by natural windbreaks?
13. Is the air drainage good?
14. What natural advantages are there which favor the location of the building?

Data to be secured from farmers or other sources:

1. Secure the following information. These data will be serviceable in determining the regions adapted for poultry farming.
   (*a*) Seasonal temperature, maximum and minimum.
   (*b*) Seasonal rainfall, maximum and minimum.
   (*c*) Sunshine, maximum and minimum.
   (*d*) Direction and force of prevailing winds.
   (*e*) Principal markets.
   (*f*) Distance from market.
   (*g*) Population of the near-by markets.
   (*h*) Distance from the local station.
   (*i*) Express rate on eggs .... Dressed poultry .... Live poultry ....
   (*j*) Freight rate (per ton feed).
   (*k*) Passenger rate to the market.
   (*l*) Frequency of train service to the market.
   (*m*) Hours for express shipments to reach the market.
   (*n*) Are cooperative egg markets available?
   (*o*) What is their nature?
   (*p*) What are their advantages?
   (*q*) Condition of the roads in the neighborhood during bad weather.
   (*r*) How are the roads kept in repair?
   (*s*) What are the educational advantages in the community?
   (*t*) What are the religious advantages in the community?

(*u*) What are the social advantages in the community?
(*v*) What can be said of the character, progressiveness, and prosperity of the people of the community?
(*w*) What organizations are in operation—Grange, clubs, associations, etc.?
(*x*) Is trolley or bus service available?
(*y*) What is the cost per year for telephones?

2. What do you consider the advantages of a colony system of housing mature stock?
(*a*) Is there less danger from fire?
(*b*) Is there less trouble from disease carried from flock to flock?
(*c*) Is the original cost greater?
(*d*) Is the labor cost higher?
(*e*) Are the houses cold?
(*f*) Are the colony houses more convenient?
3. What do you consider the advantages of a single-story continuous system of housing mature stock? Of the multiple-story house?
(*a*) Is it cheaper per bird to construct?
(*b*) Is the operation cost less for labor?
(*c*) Are the houses warmer?
4. What influences do the following have on the location of the laying and breeding house?
(*a*) Range.
(*b*) Accessibility.
(*c*) Exposure.
(*d*) Protection.
(*e*) Air drainage.
(*f*) Safety.
5. In the following list, check the uses made of the service building:
(*a*) Feed storage and mixing.
(*b*) Work shop.
(*c*) Egg room for candling and packing.
(*d*) Killing and picking.
(*e*) Incubation room.
(*f*) Office.
(*g*) Storage for crates, supplies, and equipment.
6. Why did you select this location for a poultry farm?
7. In what order were the buildings constructed or remodeled? What buildings were on the place when you acquired it?
8. What do you regard as the advertising value of this location?
9. Do you contemplate enlarging the plant and layout? If so, how and why?

10. From the standpoint of the community, what schools are available? What churches?
11. What are the nationality and attitude of the neighbors?
12. Have you installed soil drainage?
13. What crops do you grow? Area of each?
14. Would it be advantageous to have more land and grow more crops?

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